Ākāśa Darśana Atlas

ĀKĀŚA DARŚANA ATLAS

G. R. PARANJPE

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Introductory Note

The sky, particularly the night-sky, has always attracted the attention of both young and old. This wonderful phenomenon of nature has often been presented to children, wrapped up in stories woven round those glittering bodies floating in the sky.

To guide and initiate the children into the mysteries of this most fascinating part of the universe, there already exists a variety of literature on the subject. *ĀKĀŚA DARŚANA ATLAS* is one more addition to such literature. Written by such an eminent person as Professor G. R. Paranjpe, the Atlas is profusely illustrated with very useful and interesting maps on the movement, behaviour and significance of different celestial bodies that appear and disappear in the sky during the different months of the year.

The National Council of Educational Research and Training is grateful to Professor Paranjpe for preparing the Atlas, and also for supervising its printing under his meticulous care.

It is hoped that the Atlas will be found very useful by all, and that it will specially enthuse the young readers to take to a more detailed study of, as Professor Paranjpe terms it, "one of the remarkable gifts of nature" — the night-sky.

SHIB K. MITRA
Director
National Council of Educational
Research and Training

New Delhi
14 March 1978

Foreword

I appreciate the privilege given to me by the author to write a foreword to his recent contribution for the benefit of the common man — ĀKĀŚA DARŚANA ATLAS : Latitude 25° N (say, Varanasi). His earlier version published in 1972 related to Latitude 18° N (say, Pune), and being in Marathi it did signal service to the promotion of popular science literature in that language.

Astronomy, the oldest of sciences, by its phenomenal progress over three thousand years, has fully justified Pascal's pertinent remark : " man may be less than even a tiny speck in this vast world, but his mind can encompass the whole universe." Even without the modern aids and discoveries of science, our ancient star-gazers found so much about the celestial sphere that surrounds us – the rhythm of the rising and setting of the sun, the phases and the motions of the moon. The regular appearance of night stars attracted their attention. They chose clear nights to go to places which afforded a good view in all directions near the horizon. In the course of only half an hour they could notice the apparent movement of the heavens. Those in the middle latitudes of the northern hemisphere, looking to the east (direction of sunrise) saw the stars rising and simultaneously moving to the right uniformly at the rate of 15° an hour. In the south also, stars were found moving to the right but neither rising nor setting. Facing west, the movement was to the right and downwards. But when they turned to the north, the movement of stars was seen quite like that in the south near the horizon, but found their motion much slower. When they looked upwards equal to their own latitude, the stars appeared to have no motion. They were in fact looking towards the celestial north pole. About one degree from this pole is the bright star known as Polaris, or the Pole Star.

The obvious explanation that struck these early star-gazers was to assume that the stars are fixed on the heaven (a sphere of vast radius) and that the entire heavenly sphere is rotating about an axis through the observer and the celestial pole. This axis is parallel to the axis of the earth and as the stars are at a very great distance compared to the diameter of the earth, the celestial sphere appears to rotate about an axis through the observer, instead of through the centre of the earth.

To the observers in the southern hemisphere, left must be replaced by right and north and south must be interchanged in the above description.

To an observer at the equator, with the celestial poles on the horizon, all stars appear to rise and set vertically.

This simple explanation of the rotation of the heavens about the axis, passing through the celestial poles, properly accounted for the observed movements of the stars—but not of the planets. Ptolemy suggested ingenious and complicated use of cycles and epicycles.

The human mind registered a significant advance when Copernicus (1473-1543) suggested that the sun is the centre round which planets moved and that the earth was rotating about its own axis in a day.

It is again remarkable to note that merely by star-gazing and visual observations, Kepler (1571-1630) discovered the three laws of planetary motions in elliptic orbits, with the sun at the focus. But his results were based on twenty years of star-gazing and visual observations by Tycho Brahe (1546-1601) before him.

With Galileo (1564-1642) began the era of optical telescopes. When, on 7 January 1610, with his own hand-made crude telescopic device he saw the satellites (moons) of Jupiter, it was remarked that "He scaled the very walls of heaven." He died in 1642 and eleven months later in that very year Newton (1642-1727) was born. Newton's discovery of the Universal Law of Gravitation accounted theoretically for the Kepler's Laws of Planetary Motion, based on observations. This was, indeed, an epoch-making event. Since Galileo's times optical telescopy has made enormous advance; such as the two hundred-inch (reflector) telescope, described as 'the glass giant at Palomar'. Man opened another window to view the universe — namely, the radio-telescope at Jodrell Bank. All this technological progress, with stellar photography, X-ray telescope, etc., has now enabled us to speculate rationally on the history (origin) and geography (expanse) of our universe – which may be just one of the many universes.

Prof. G. R. Paranjpe has, amidst such exciting times, done well to help us to see the universe without the help of sophisticated aids of science. The stellar maps in five different directions easily enable us (at Lat. 25° N) to see with the naked eye the pictures that the sky presents at different periods of time. For observers in different parts of India, a table for conversion of Local Time to Indian Standard Time is provided in the

text and there is also attached another table for those who choose to observe the night-sky at different hours, throughout the year.

The book is particulary helpful in India which is blessed with clear nights for the most part of the year. Many of us use, in our daily routine, the western calendar. The present book will familiarise us with our 27 NAKṢATRA (नक्षत्र) and their corresponding constellations known to the west. Unlike his earlier publication in Marathi, the present Atlas, being in English, will command a much wider public and rouse national interest. The author has done well to include brief notes on atomic energy, quasars, pulsars, neutron stars, etc. There is also some information on the history and origin of the Arabic nomenclature of stars.

Now just a remark or two before I close. First, the pictures of the position of stars in the sky, faithfully depicted in the book, are in the nature of things distorted. They cannot show the reality. For example, take any constellation. Its constituent stars are at widely different distances away from us. The rays, that leave them, have to travel long distances of different light-years to reach us. What we actually see is as untrue as, for example, a photograph in which persons widely separated by space and time are sitting close together.

Secondly, regarding the history (origin) of the Universe, two theories are in the field— (i) the big–bang theory and (ii) the steady–state theory. The former raises the question whether Nature's (physical) laws have remained the same since the bang occurred or are (may be slowly) constantly changing. This question does not arise, if we accept the steady-state postulate. But they claim that, at present at any rate, the evidence in favour of the big–bang is stronger.

Fifty years ago (1928), Prof. Paranjpe with the collaboration of his colleagues started his SṚṢTIJÑANA (सृष्टिज्ञान) which has been, month after month, feeding the public with popular science fare. His '*ĀKĀŚA DARŚANA*' today should serve the same purpose. Who wins in the competition for excellence ? Question is asked but judgement is reserved.

G. S. MAHAJANI
Formerly, Principal of the Fergusson College, Pune
and
Vice-Chancellor of Jaipur, Delhi, Udaipur and Pune Universities

Pune
18 January 1978

Preface

ĀKĀŚA DARŚANA ATLAS is meant to be a book for everybody. A librarian will classify such a book under Astronomy and yet the book is free from any serious study of astronomy, mathematics or general science. This Atlas is designed to create a desire to acquaint oneself with what one sees in the night-sky. It gives an account of the strange appearances that take place night after night. It is, however, hoped that a systematic reference to the Atlas will induce a careful reader to undertake the study of astronomy.

Night-sky is one of the remarkable gifts of Nature. Events occur in the night-sky with extreme precision. In fact, it is said that measurement of time has its beginning with regular observations of the movements of the sun and stars in the sky, by day and by night. A great deal of the past history of the Āryas can be studied from the innumerable references, in the ancient Vedic literature, to stellar objects and their appearances.

To recognize a star and to know something more about it is the first step. The game begins to become more and more fascinating when you look at the sky through a binocular or a small telescope. Barring some overcast nights, during the rainy season, the Indian night-sky is generally very clear. It is studded with stars. This Atlas will help the reader to identify, at least, the more prominent and bright stars.

The visible hemisphere of the night-sky cannot be entirely observed all at once. Therefore, it is divided into five sections. Each section consists of only that much part of the sky that can be viewed easily, successively facing the North, East, South and West. The overhead sky is called the Zenithal section, and to look at this, one must lie flat on the ground and face upwards.

This Atlas is designed mainly for observers in India and based on Latitude 25° North. The time is chosen at 20.00 hours, Indian Standard Time, on the night of the 15th of each month. To observers at other places, there will be slight variations as can be realised from the fact that the northernmost city of Srinagar is at Lat. 34° N and the southernmost city of Trivandrum is at Lat. 8° N. According as the place of observation is to the east or west of Varanasi, there will evidently be variations, although slight, on account of the Longitude. A detailed correction table, for most important cities in India, is provided and it gives the difference between the Local Time and the Indian Standard Time.

Although these night-sky views are designed for a particular time and night, it is possible to use these charts for observers who choose to look at the night-sky on any other night and at any other time. A separate table giving the necessary information, in this correction, is furnished in the book for the convenience of such observers.

There are five night-sky views for each month. Side by side with these there are corresponding key-maps, giving the following details :

(i) names of stellar objects, as in International use and as in Indian literature,

(ii) multiple stars, nebulae, clusters that can be seen either with the naked eye or with easily obtainable aids, such as a telescope or a binocular.

(iii) co-ordinates such as R. A. or Hour Angles and Declinations are provided,

(iv) such important landmarks as the Ecliptic Circle, the Milky Way, the Precession Circle are indicated.

Important information of a basic nature is given in the introductory pages of the Atlas. This consists of items like Astronomical Terms and their Meanings, Measurement of Time, Corrections for Local Time, Units of Distances, International Names of Constellations and Stars and their Indian Equivalents.

Four special charts are also provided. They show different constellations in the form of fanciful pictures of animals and birds as conceived by the ancients. Some of these are based on old pictures and some are new, but they are all put together with a view to creating added interest in observation of the night-sky.

Interesting accounts of constellations, as found in ancient lore of the East and the West, are provided along with a great deal of basic information like Precession of Equinoxes, the Milky Way, Nebulae and Star Clusters, Meteoric Showers, Phases of the Moon, Comets, Approaching and Receding Stars, Stellar Temperatures, Giant Stars and Dwarfs, Radio Telescope, Galaxies, Quasars, Nuclear Reactions, Evolution of the Universe, etc.

Night-sky Maps of this kind were first published, serially, in the Marathi Popular Science Magazine "SṚṢṬIJÑĀNA" (सृष्टिज्ञान) during 1964-65, 1965-66 and 1966-67. It was soon suggested by friends that a publication of this type in all Indian languages would prove very interesting and useful. On the recommendation of the NCERT, fresh maps were prepared for the Lat. 25° N for this English version.

A fairly exhaustive Subject–Index is supplied at the end for easy reference to the large number of different items mentioned in the text.

Acknowledgement of references is made with due respect and gratitude to the authorities concerned. Among the books used freely for information, diagrams, photographs, illustrations, etc., some titles are mentioned under Acknowledgement.

My special thanks are due to the Jyotirvidyā Parisansthā, a bode devoted to the study of astronomy, and in particular to my friend Shri M. N. Gokhale of the Indian Meteorological Office, Pune, who carefully checked up the maps and descriptions.

I am grateful to my colleague Prof. M. W. Chiplunkar who allowed me to use his drawings from his article on "the Ringa of Saturn and Uranus" published in a local paper. My special thanks are due to Prof. G. H. Khare, the Chairman of the Bharat Itihasa Samshodhan Mandir, Pune, in the matter of the Arabic names in the article, at the end, on Star Names and their Meanings.

I am indebted to the Maharashtra State Board of Literature and Culture for arranging a Marathi publication of the "SṚṢṬIJÑĀNA ĀKĀŚA DARŚANA Atlas" based on Lat. 18° N in 1972. This English version of the "ĀKĀŚA DARŚANA Atlas" based on Lat. 25° N is being published by the National Council of Educational Research and Training and I am greatly indebted to that body. In this manner, it book is expected to reach all the different linguistic regions in India, for easy adaptation in the local languages, with the night-sky and key-maps remaining unaltered.

Before I close, I must express an apology to the reader. Owing to the occurrence of a large number of unfamiliar names and symbols, several printing errors have remained undetected. An attempt has, therefore, been made to provide extensive errata, and the readers are requested to make use of the same.

'Sudarshan'
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30 January 1978

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Acknowledgement

Acknowledgement of references is made with due respect and gratitude to the authorities concerned. Among the books used freely for information, diagrams, photographs, illustrations, etc., the following must be mentioned :

S. B. Dixit	1948	Jyotirvilās (Marathi) 2nd Ed.
T. G. Dhawale	1956	Jyotirvaibhava (Marathi)
T. G. Dhawale	1955	Nakṣatra Darśana (Marathi)
Dr. Ernst and Tj. E. de Vries	1961	Atlas of the Universe (Nelson)
A. P. Norton	1966	A Star Alas (Gall and Inglis)
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F. A. Grondal	1937	Romance of Astronomy (Music of the Spheres) (MacMillan Co., New York)
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Contents

1

How to Fix Directions at Night

WHILE WE are in the Northern Hemisphere, we shall be able to see the Pole Star in the clear night-sky, every night, at all hours and throughout the year. The Pole Star is identified from the fact that it occupies almost the same position in the sky always. The Indian name is *DHRUVA TĀRĀ* (ध्रुव तारा), meaning a star which is stationary. If we, therefore, succeed in finding out the Pole Star in the night-sky, we shall know the North direction with an accuracy that would be sufficient for our purpose.

Looking towards the northern sky, in a very general manner, at about 8 p.m. in the month of January, we cannot fail to notice a peculiar group of five bright stars, well above the horizon, making the figure of an inverted letter W of the English alphabet. This constellation is called Cassiopeia or *ŚARMIṢṬHĀ* (शर्मिष्ठा) and it can be seen as lying inside the long white band spread out in the sky. This white band is known as the Milky Way. On the right-hand side of Cassiopeia and somewhat close to the horizon we can see two bright stars. They are part of the constellation Great Bear (Ursa Major) or *SAPTARṢĪ* (सप्तर्षी). This constellation will be coming out of the horizon almost within an hour and then it will look like a kite, having four stars at the corners of the kite and three stars in its tail. The two stars which were already above the horizon at 8 p.m. are called the Pointers, because they are directed towards the Pole Star which we are looking for. Drawing a line through the Pointers and extending the same towards the left, almost half-way between the Pointers and Cassiopeia, or at a distance of about $5\frac{1}{2}$ times the distance between the Pointers, we see a relatively bright star. It can be located without much difficulty because there are no other bright stars in its vicinity. This star is the Pole Star, otherwise called Polaris.

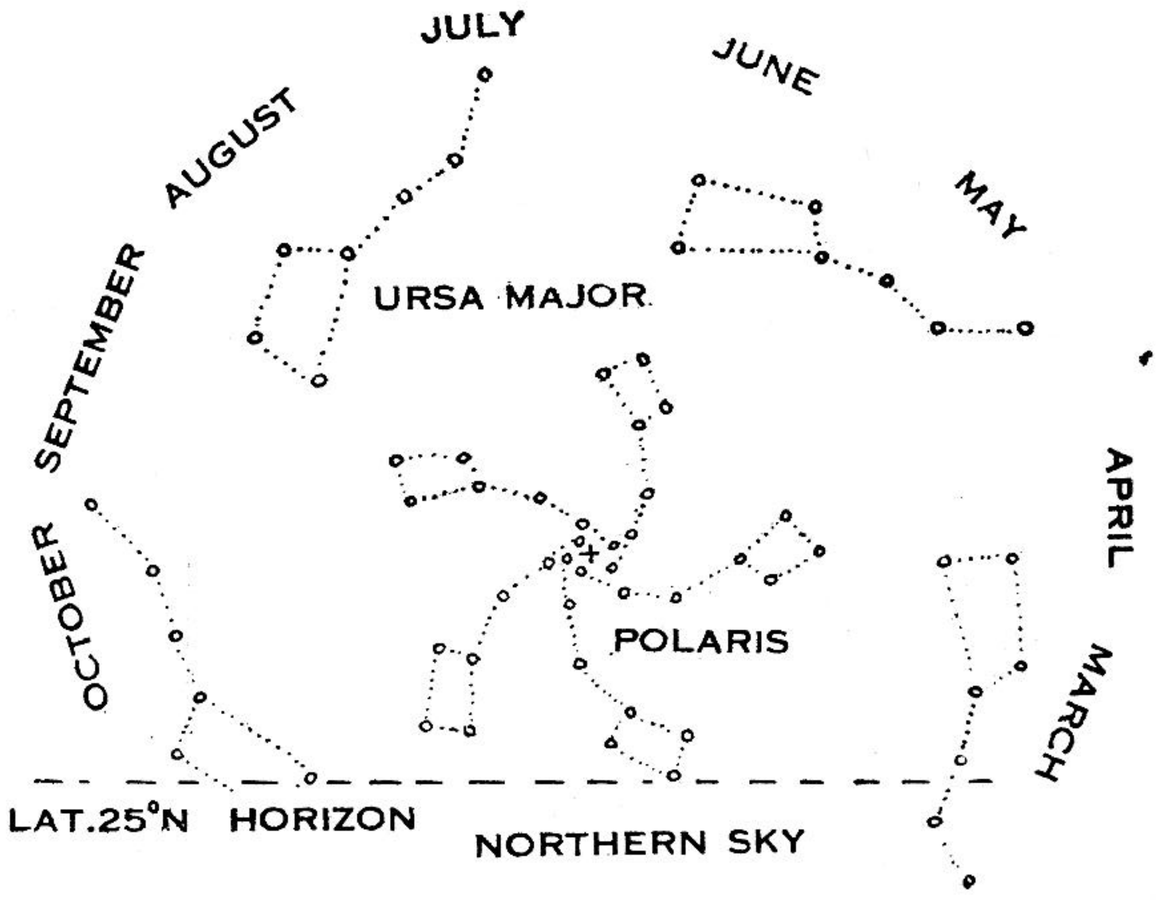

Fig. 0.1 Fixing Directions at Night

When we stand facing the Pole Star, we are facing Due North. Due West is on our left, Due East on the right and Due South behind us. That gives us all the major directions at night-time.

The Celestial Sphere is continuously rotating about the Celestial Axis from east to west and this results in the rising and setting of stars. The real cause of this apparent rotation is, however, the rotation of the earth about its own axis. The time taken for one complete rotation is called the Siderial Day. The Celestial Axis is the extension of the earth's axis both ways, towards the north and the south. The Pole Star is situated in space very near the Celestial Axis at the present time

and, therefore, we say that the Pole Star is fixed. The fact, however, is that the Celestial Axis describes a cone, with the result that different stars, on the circle of the base of the cone, obtain by turn the status of a Pole Star during a period of about 26,000 years.

The Pole Star is at the tail-end of the constellation, which has very much the same shape as that of Ursa Major or the Great Bear. This constellation *DHRUVAMATSYA* (ध्रुवमत्स्य) is, therefore, called Ursa Minor or the Little Bear.

Being situated near about the Latitude 25° North, it is possible for us to observe nearly half the rotation of Ursa Minor, with the Pole Star as its pivot, from any evening to the following dawn.

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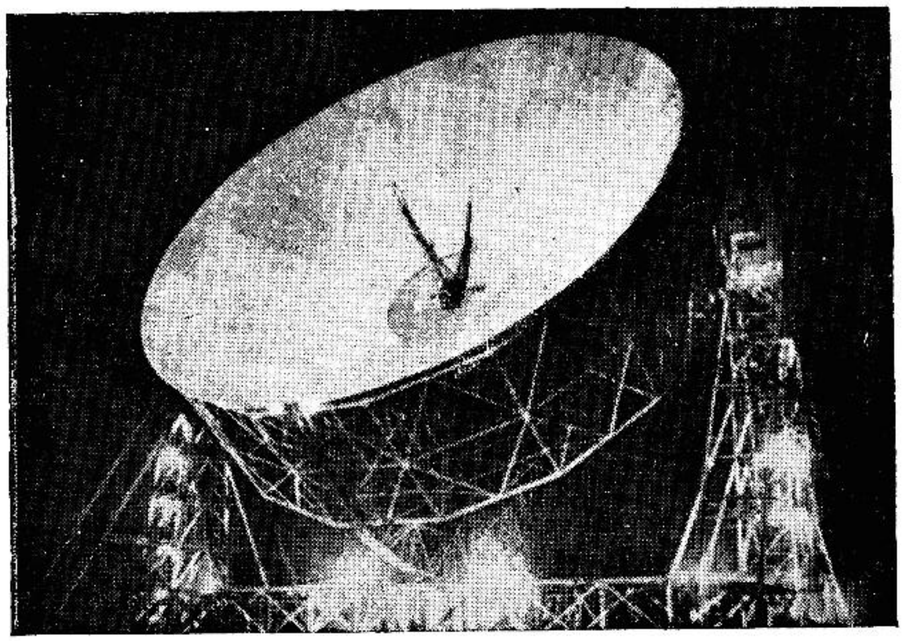

2

Some Astronomical Terms

THE CELESTIAL SPHERE is an imaginary sphere used to describe the celestial phenomena and to define the positions of points in the sky.

The idea is that the Celestial Sphere is of an infinite radius and that the observer is always at its centre.

The Celestial Equator is the imaginary Great Circle drawn on the surface of a celestial body at right angles to its axis of rotation.

The Celestial Equator is the line along which the plane of the earth's equator intersects the celestial sphere.

Equinoctial is another name given to the Celestial Equator.

The Northern and Southern Hemispheres are names for the two divisions of the rotating Celestial Sphere made by the Celestial Equator.

A System of Coordinates to define the positions of points in the sky is based on the Celestial Equator.

Celestial Coordinates are Right Ascension (R. A.) and Declination.

The Right Ascension of a star is the angular distance measured in the direction opposite to the diurnal rotation, from the Vernal Equinox to the intersection of the Declination Circle of the star and the Celestial Equator.

Hour-Angle : The Celestial Equator is divided into 24 hours. R. A. is, therefore, normally expressed in terms of Hours, Minutes and Seconds.

R. A. is independent of the daily rotation of the Celestial Sphere. R. A. is often called Hour-Angle and it is one of the celestial coordinates. The other celestial coordinate is the Declination.

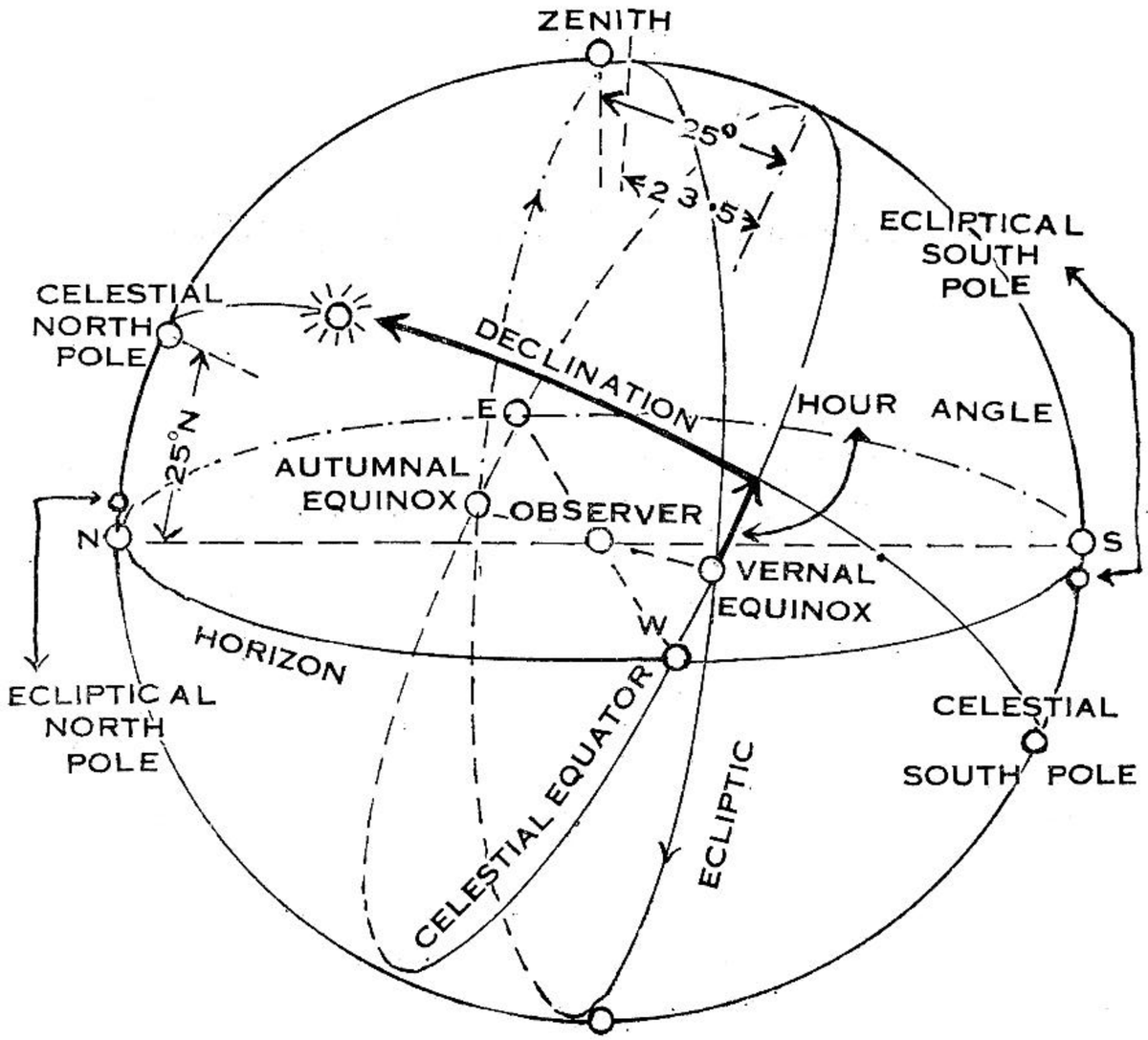

Fig. 0.2 Some Astronomical Terms

Declination is one of the coordinates in the system based on the Celestial Equator. The Declination of a star is measured along the Great Circle passing through the star and the two Celestial Poles. The Declination is, therefore, measured perpendicular to the Celestial Equator. Declination is really the arc of the Declination Circle measured from the intersection of the circle and the Celestial Equator to the star. The Declination is measured positive towards the North Pole and negative towards the South Pole.

It must be remembered in this connection that *it is not the actual points in space which are defined by these coordinates*, but the points where the radii through them meet the sphere. All objects are, therefore, regarded as being equally far from the observer.

The Celestial Axis is the axis round which the Celestial Sphere appears to rotate. The axis of the earth, extended in both directions, would be the same as the Celestial Axis.

The Celestial Poles are the points of intersection of the Celestial Axis on the Celestial Sphere. They are on the extension lines towards the North and the South Pole.

Ecliptic is the path followed by the sun on its apparent yearly journey, in relation to the stars, on the Celestial Sphere.

Equinoxes : The plane of the Ecliptic passes through the centre of the sun as well as through the centre of the earth. As seen from the sun, the Ecliptic is the earth's annual orbit round the sun. The Ecliptic is a great circle inclined at 23.5° to the Celestial Equator. It cuts the latter at two points. These points are called *Equinoxes*.

Vernal Equinox (R. A. O h., Decl. 0°) is the point of intersection of the Ecliptic with the Equator. The sun reaches it on 21 March, and moves from the southern to the northern half of the Celestial Sphere.

Autumnal Equinox (R. A. XII h., Decl. 0°) is the point which the sun reaches on 23 September, and moves from the northern to the southern half of the Celestial Sphere.

Summer Solstice and Winter Solstice : The sun attains the greatest Declination north and south, respectively, on 21 or 22 June and 21 or 22 December. Of these, the first is called the *Summer Solstice* (R. A. VI h., Decl. 23.5° N.) and the second is called the *Winter Solstice* (R. A. XVIII h., Decl. 23.5° S). The meaning of the word Summer Solstice indicates that the sun, before descending to the Autumna Equinox, seems to stand still for some time. The same thing happens at the Winter Solstice.

* * *

3

Measurement of Time

STANDARD MERIDIAN is the Great Circle passing through the North Pole, the South Pole, and Greenwich Observatory in U. K.

Local Meridian is the Great Circle passing through the North Pole, the South Pole, and the station where the observer is situated.

Universal Time (U.T.) or (T.U.) is measured with reference to the Greenwich Meridian, beginning with zero hour at midnight.

Local Time (L.T.) is measured with reference to the Local Meridian, and it differs from the Universal Time at the rate of +4 or −4 minutes per degree, according as the observer's meridian is East or West of the Standard Meridian through Greenwich.

Indian Standard Time (I.S.T) is reckoned at Longitude 82° 30' East of Greenwich and thus I.S.T. is 5 hours and 30 minutes in advance of U.T. or Greenwich Mean Time.

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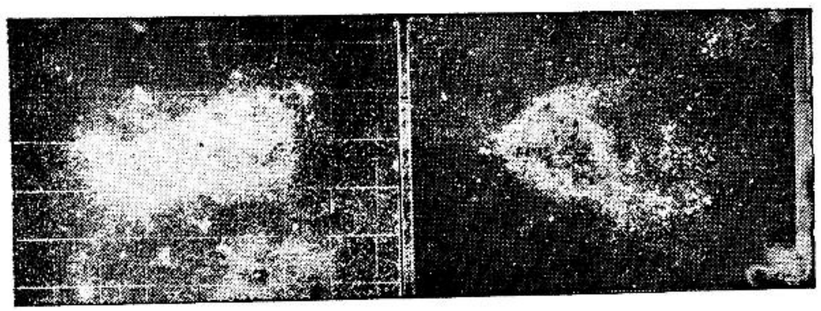

4

Correction for the Longitude

LONGITUDES and Latitudes of some Indian cities, along with the differences between their Local Time and the Indian Standard Time.

Greenwich Mean Time (G.M.T.) — Indian Standard Time (I.S.T.) = 5 Hrs. 30 Minutes.

Indian Standard Time (I.S.T.) + 5 Hrs. 30 Minutes = Greenwich Mean Time (G.M.T.)

1 Name of the Place	2 Latitude N deg. min.	3 Longitude E deg. min.	4 Difference between Local Time and Indian Standard Time in Minutes (L.T.—I.S.T.)
Ahmedabad	23 04	72 38	— 39.5
Allahabad	25 27	81 44	— 3.0
Aurangabad	19 53	25 20	— 26.8
Vārāṇaśī (Benares)	25 18	83 01	+ 2.0
Bangalore	12 58	77 35	-- 19.0
Belgaum	15 51	74 32	— 31.9
Bombay (Colaba)	18 54	72 49	— 38.7
Calcutta (Alipore)	22 32	88 20	+ 23.03

1 Name of the Place	2 Latitude N deg. min.	3 Longitude E deg. min.	4 Difference between Local Time and Indian Standard Time in Minutes (L.T.—I.S.T.)
Chandigarh	30 44	78 53	— 23.5
Cuttack	20 28	85 56	+ 13.7
Delhi	28 35	77 12	— 20.1
Hyderabad	17 27	78 28	— 16.1
Indore	22 53	75 48	— 27.0
Jabalpur	23 10	79 57	— 10.2
Jodhpur	26 18	73 01	— 38.0
Lucknow	26 52	80 56	— 6.3
Madras	13 04	80 15	— 9.0
Nagpur	21 06	79 03	— 13.8
Patna	25 37	85 10	+ 10.7
Pune (Poona)	18 32	73 51	— 34.6
Raipur	21 14	81 39	— 3.4
Shillong	25 34	91 53	+ 37.5
Simla	31 06	77 10	— 21.3
Srinagar	33 59	74 47	— 30.9
Trivandrum	08 28	76 57	— 22.2
Ujjain	23 11	75 47	— 27.0
Waltair	17 41	83 18	— 3.2

* * *

5

Some Units of Distances

THE UNIT of length is 1 centimeter. Distances on the earth are measured in kilometers, where 1 km. = 1,000 meters,

1 meter = 100 centimeters.

Distances between stellar objects are very much larger than terrestrial distances, therefore different larger units are employed.

Astronomical Unit is the unit of length used in measuring distances within the solar system, and it is indicated as :

A.U. = mean distance from the earth to the sun.

1 A.U. = 149,450,000 kms. = 500 light-seconds.

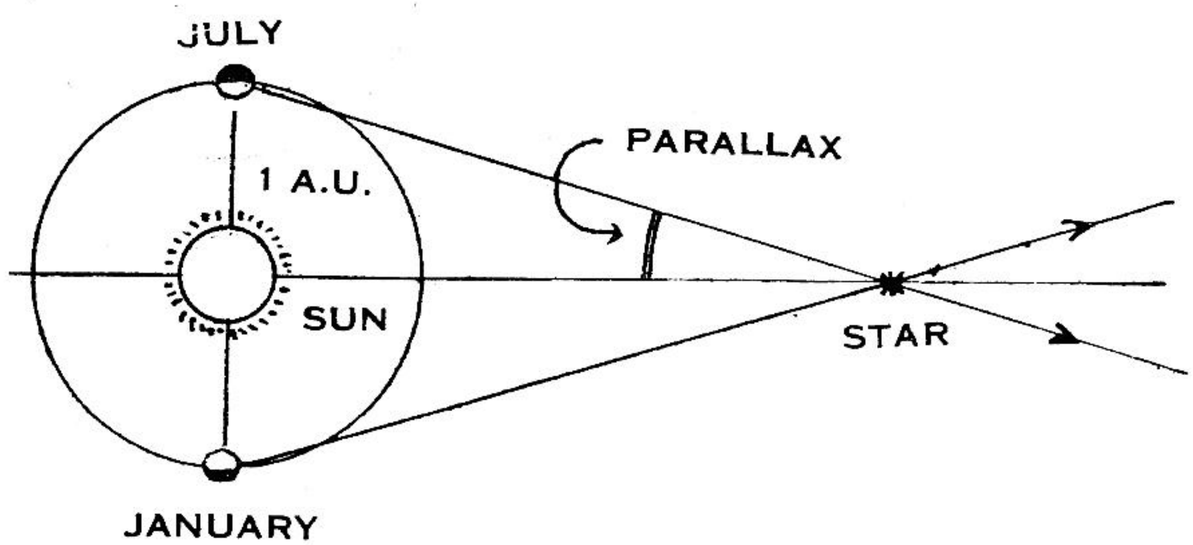

Fig. 0.3 Astronomical Unit of Distance : A.U.

Light-Year is the unit of length for measuring distances larger than the expanse of the solar system, particularly distances between the stars. One light-year is the distance travelled by light in one year.

The velocity of light = 2.9985×10^{10} cm. per sec.
Therefore, 1 light-year = 9.460×10^{12} kms.
= 63271 Astronomical Units (A.U.)
= 0.307 par-sec.

Par-sec is another unit of length for measuring stellar distances, and it is mostly used for very very large distances of stellar objects outside our galaxy known as the Milky Way.

Parallax of a star is the angle subtended at the star by the radius of the earth's orbit. If the parallax of a star is 1 second of arc (1″), its distance is said to be 1 par-sec.

1 par-sec = 206,265 Astronomical Units
= 3.26 light-years = 3.086×10^{13} kms.

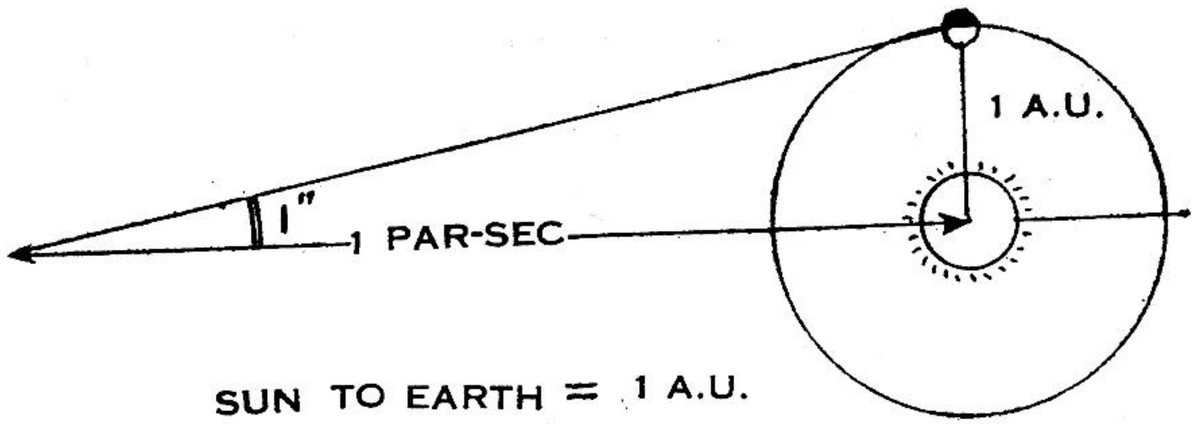

Fig. 0.4 Astronomical Unit of Distance : Par-sec.

* * *

6

Telescopes

TELESCOPE is a very important aid for systematic visual and photographic observation of stellar objects. A telescope, indeed, does something which the naked eye cannot do. It collects more light and thus enables the fainter stars to be seen. It also determines the direction of the stellar object from the observer, of course, with reference to some standard and predetermined direction, in terms of an angular measurement. This enables astronomers further to define and keep a record of all objects observed. A telescope also magnifies the images of objects viewed through it.

A telescope makes use of a mirror or a system of lenses to collect the light coming from a distant object. This part of the telescope is called the objective because it is turned towards the object to be viewed. If a mirror is used, the telescope is called a *Reflector*. If a lens system is used, it is called a *Refractor*. The mechanism of a telescope is, in principle, very simple. The objective forms a reduced image of the distant object. This small image is afterwards magnified by another system of lenses, which is called an eye-piece. The eye-piece is next to the observer's eye.

Special devices are employed in conjunction with the telescope for measuring special properties of the objects viewed. For instance, (1) a camera attachment takes a photographic impression which one can examine at leisure, (2) a spectroscopic attachment analyses the light of

the observed object, (3) a photo-electric cell attachment measures the luminosity or the light energy which reaches us, (4) a thermo-couple measures temperature enabling the observer to make an estimate of the temperature at the source.

In a Reflector, or reflecting telescope, the main advantage is that the image is free from colour defects, known as chromatic aberration. But before Galileo, telescopes were not known at all and astronomers relied

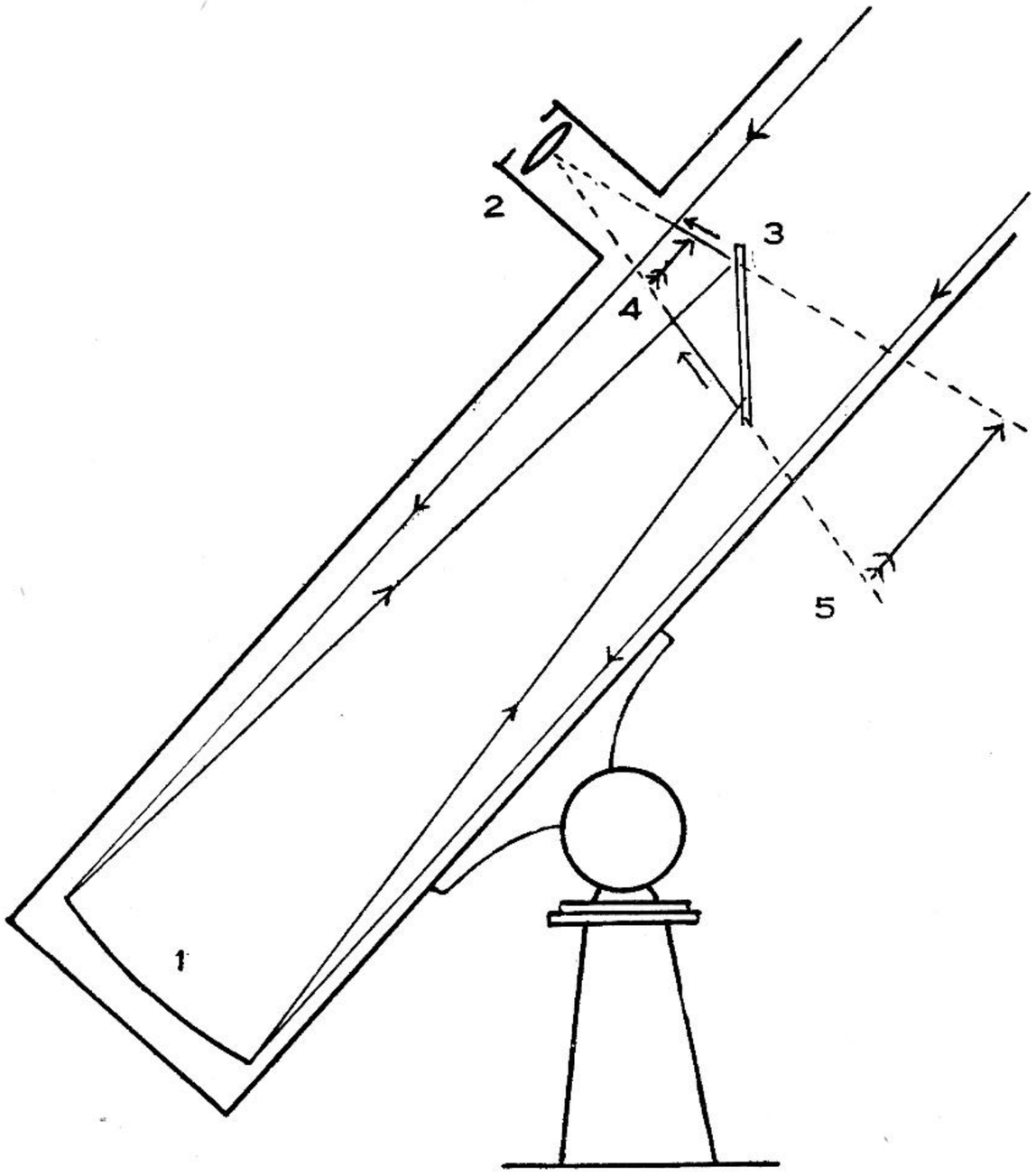

Fig. 0.5 Reflector Telescope

1. Concave mirror : Objective 2. Eye-piece 3. Plane mirror
4. First image 5. Magnified image

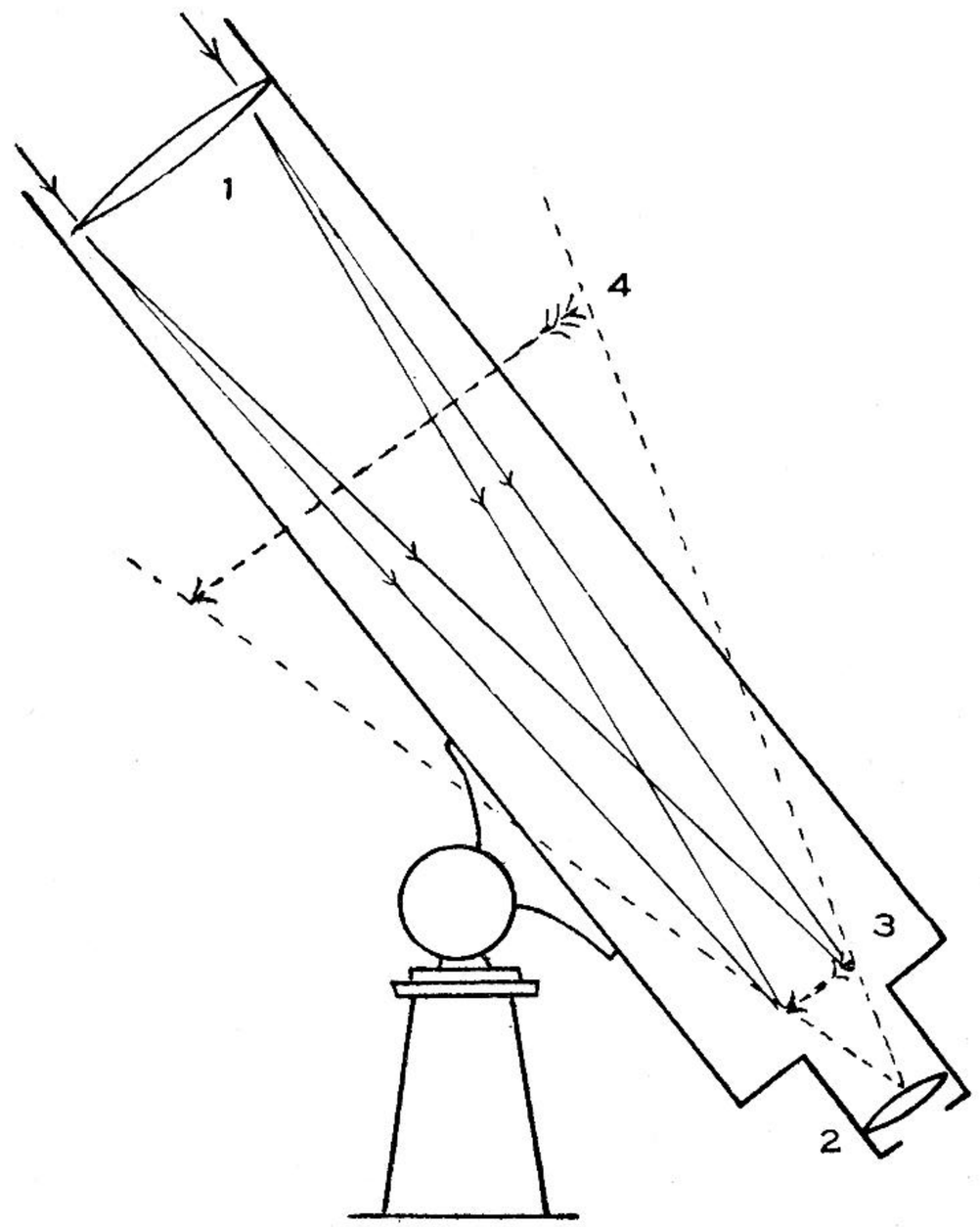

Fig. 0.6 Refractor Telescope

1. Convex lens : Objective 2. Eye-piece 3. First image
4. Magnified image

on their eyes in making observation. Galileo is considered to be the inventor of the telescope. The quality of the telescope improved with time and with the improved knowledge of optics. Galileo's telescope had a system of lenses for its objective. This went on until the second half of the eighteenth century when the Reflecting Telescope came to be used with greater preference, particularly for astronomical observation.

The quality of a telescope is measured in terms of its Resolving Power. The resolving power of a telescope is the angular distance between two sources of light which the telescope can just distinguish as separate or individual points. The magnifying power of a telescope has a limit, because beyond certain limitations the magnification cannot be extended owing to the quality of the glass used. The resolving power also has a limit and the limit is determined in terms of the aperture of the objective and in terms of the wave-length of the light employed. The greater the size of the objective, the greater is the resolving power. Increase in the diameter of a lens, however, beyond 40" (101 cms.) gives no additional advantage in gathering light. One of the reasons for this restriction is that as the diameter of the lens increases, its thickness also has to increase and with it comes greater absorption of light. Therefore, astronomers indicated their preference for reflecting telescopes. In such instruments, there is no absorption at the objective.

The largest Reflectors are :

The Mount Wilson Telescope of 100" (254 cms.) made in 1918 and the Mount Palomar Telescope of 200" (508 cms.) made in 1948.

Radio Telescope is now being used in making astronomical observation of very far stellar objects. Its description and working are given later in a separate article (see page 211).

The first Radio Telescope in India was conceived by the Tata Institute of Fundamental Research and was erected at Ooty in the Nilgiri mountains in South India in the year 1973.

* * *

7

The Magnitude of a Star

A STAR is a gaseous celestial body, like the sun, extremely hot and, therefore, incandescent like the filament of an electric lamp. According to the amount of radiation energy a star gives out, it is said to possess greater or less luminosity. Luminosity is like the candle-power of a lamp. When we see a star, we can only estimate its brightness in appearance and place it at a certain point in a scale of brightness arbitrarily prepared. This brightness gives us the star's *apparent magnitude.*

Since the time of Ptolemy, the brightest star and the faintest star were described as a star of magnitude 1 and a star of magnitude 6, respectively. Now it is known from radiation measurements that the intensity of the radiation received from a star of magnitude 1 is about 100 times that received from a star of magnitude 6. The ratio of their brightness is, therefore, 100:1. Since the fifth root of 100 is 2.512, we can say that a star of magnitude 5 is, by definition, 2.512 times brighter than a star of magnitude 6. This is only a scale of brightness. Anything brighter than a star of magnitude 1 would be indicated with a fraction or with a negative sign. For instance, the star Capella has magnitude 0.2, and the star Sirius has magnitude —1.6. The brightness of the full moon would be of magnitude —12.6. While the magnitude of a just visible star is 6, the magnitude of telescopic stars could be as much as 19 or more, depending on the power of the instrument.

The visible brightness of a star is used in estimating its magnitude. This magnitude is, therefore, called *apparent magnitude*. The *absolute magnitude* would, evidently, be different from the apparent magnitude. It will be dependent on the actual amount of radiation sent out by the star which is measured as the *luminosity* of the star. The luminosity can thus be compared with the candle-power of a lamp. It is common experience that when we look at street lamps, which are known to have the same candle-power, the nearer lamps will appear brighter than the lamps in the distance. With a view to eliminating the effect of the distance, it is customary to compare the brightness of the stars on the assumption that they are all at a uniform distance of 10 par-secs from us. (1 par-sec = 3.26 light-years = 3.086×10^{13}km.). The brightness of a star, when reduced to this condition, is called its *absolute magnitude*.

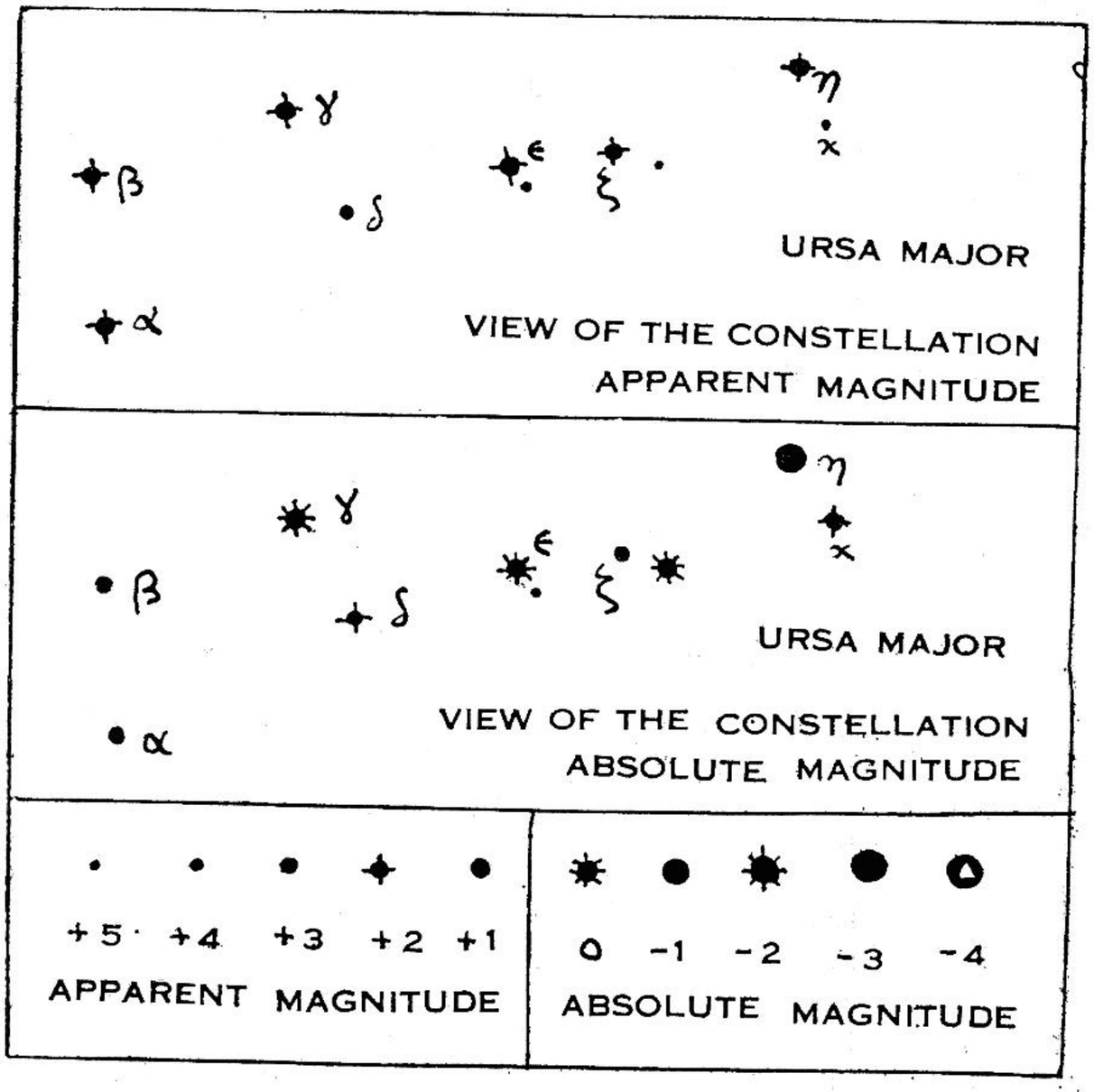

Fig. 0.7 The Magnitude of a Star

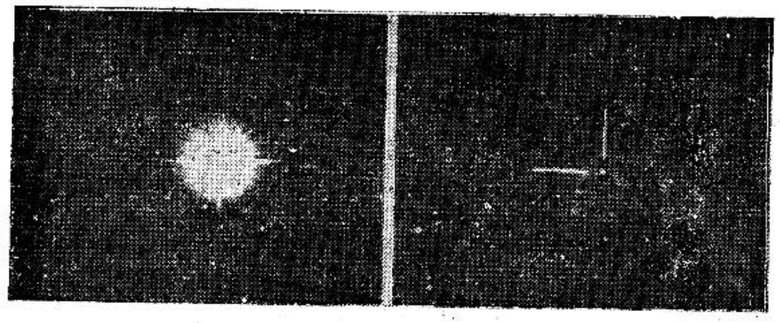

Fig. 0.8 Varying Magnitudes of the Same Star in Hercules
Left : maximum brightness on 10 March 1935
Right : minimum brightness on 6 May 1935

According to this definition, the absolute magnitude of the sun, of the brightest star and of the faintest star would be 4.9, —9 and 18, respectively. The luminosity of the brightest star would be about 500,000 times that of the sun and the luminosity of the faintest star would be about 0.0005 that of the sun. Knowledge of the absolute magnitude of a star is useful in determining its distance from us. In generally describing the brightness of a star, the apparent magnitude is evidently indicated. The brightest visible star is of magnitude 1 and the faintest visible star is of magnitude 6.

* * *

8

Constellations and Star Nomenclature

THE NAME of a constellation was primarily chosen after a particular object, bird, animal or human being which the constellation was imagined to look like. The names were selected from the Greek, Roman or Indian mythologies. Sometimes, the names signify one and the same object in Western as well as Indian astronomy; sometimes, however, they do not. For instance, (1) Scorpius and *VṚŚCIKA* (वृश्चिक), (2) Taurus and *VṚṢABHA* (वृषभ), (3) Cancer and *KARKA* (कर्क), (4) Gemini and *MITHUNA* (मिथुन). These constellations have remarkably similar pictorial representations. As against this identity of names, we have (1) Orion, the hunter, and *MṚGA* (मृग), the Antelope, and also the Head of the Antelope only and *MṚGA ŚĪRṢA* (मृगशीर्ष), (2) Ursa Major, the Great Bear, and the Seven Sages, *SAPTARṢĪ* (सप्तर्षी), with *ARUNDHATĪ* (अरुंधती), (3) Southern Cross and *TRIŚANKU* (त्रिशंकु), (4) Ursa Minor and *DHRUVAMATSYA* (ध्रुवमत्स्य), the Fish of the Immovable Pole.

There are in all 88 constellations, which are really groups of stars, very arbitrarily demarcated with well-defined boundaries. These are called constellations in Western astronomy and *NAKṢATRA* (नक्षत्र) in Indian astronomy, with the extended meaning of the word *NAKṢATRA*. Originally, only 27 *NAKṢATRA* and 12 *RAŚĪ* (राशि) were contemplated, and they were all situated on the Ecliptic. *RAŚĪ* are the counterparts of the Zodiacal signs in Western astronomy. The names of the constellations differ widely in Western and Indian astronomy, but remarkably enough the names of the *RAŚĪ* or Zodiacal signs are such that they signify the same objects in both the nomenclatures.

In modern times, many more constellations came to be added to the old list of only 27. Consequently, the names of the new star-groups are such that they have the same meaning, generally, as in Western astronomy. We shall, however, follow here the modern international nomenclature, as a matter of convenience.

It has been customary to name the bright stars in each constellation, and as such we find that many star names can be traced to Chinese, Arabic, Greek, Roman or Indian origin. Here, again, it can be observed that some names have a common meaning and some do not.

According to the accepted International Code, the stars in different constellations are called by the letters of the Greek alphabet α, β, γ, etc., according to their apparent brightness. When the letters are exhausted, numbers are used.

Nebulae and Star Clusters are either designated after the French Astronomer Messier as M 1, M 2, etc., or according to his New General Catalogue (N. G. C.), followed by certain numbers.

Twenty-four Letters of the Greek Alphabet

Symbol	*Pronounciation*	*Symbol*	*Pronounciation*	*Symbol*	*Pronounciation*
α	Alpha	i	Iota	ρ	Rho
β	Beta	κ	Kappa	σ	Sigma
γ	Gamma	λ	Lambda	τ	Tau
δ	Delta	μ	Mu	υ	Upsilon
ε	Epsilon	ν	Nu	ϕ	Phi
ζ	Zeta	ξ	Xi	χ	Chi
η	Eta	o	Omicron	ψ	Psi
θ	Theta	π	Pi	ω	Omega

* *·*

Some Bright Stars and Their Proper Names

Andromeda — *DEVAYĀNĪ*
- α Alpheratz
- β Mirach
- γ Almach

Aquarius — *KUMBHA*
- α Sadalmelik
- β Sadalsud
- γ Sadachbia — *ŚATABHIṢAKA*
- δ Skat

Aquila — *GARUḌA*
- α Altair — *ŚRAVAṆA*
- β Alshain
- γ Tarazed

Aries — *MEṢA*
- α Hamal — *MEṢA, AŚVINĪ*
- β Sheratan
- γ Mesartim
- 41 — *BHARAṆĪ*

Auriga — *SĀRATHĪ*
- α Capella — *BRAHMAHṚDAYA*
- β Menkalinan

Boötes — *BHŪTAPA*
- α Arcturus — *SWĀTĪ*
- β Nekkar
- σ Izar
- η Muphrid
- μ Alkalurops

Canes Venatici — *ŚYĀMA ŚABALA*
- α Cor Caroli

Canis Major — *BṚHADLUBDHAKA*
- α Sirius — *VYĀDHA*
- β Murzim
- δ Wezen
- ε Adhara
- η Aludra

Canis Minor — *LAGHU LUBDHAKA*
- α Procyon — *PRAŚVĀ*
- β Gomeiza

Cancer — *KARKA*
- δ — *PUṢYA*

Capricornus — *MAKAR*
- α Giedi
- δ Deneb Algiedi

Carina — *NAUKĀTALA*
- α Canopus — *AGASTYA*

Cassiopeia — *ŚARMIṢṬHĀ*
- α Shedar
- β Caph
- γ Cih — *ŚARMIṢTHĀ*

Centaurus — *NARATURAGA*
- α Al Kentaurus — *MITRA*
- β — *MITRAKA*

Cepheus — *VṚṢAPARVĀ*
- α Alderamin
- β Alphirk
- γ Alrai

Cetus — *TIMIṄGALA*
- α Menkar
- β Diphda
- o Mira

Columba — *PĀṜĀVATA*
- α Phact

Corona Borealis — *UTTARA MUKUTA*
- α Gemma, Alphecca

Corvus — *HASTA*
- α Alchiba
- β — *AÑGUṢṬHA*
- γ — *MADHYAMĀ*
- δ Algoral

Crater — *CAṢAKA*
- α Alkas

Crux — *TRIŚAṄKŪ*

Cygnus — *HAṂSA*
- α Deneb
- β Albireo
- ε Gienah
- π Azel falage

Delphinus — *DHANIṢṬHA*
- α Nicolaus
- β Venator

Draco — *KĀLEYA*
- α Thuban
- β Alwaid — *ṚITA*
- γ Rastaben, Etamin. — *SATYA*

Eridanus — *YAMUNĀ AGRA-NADA*
- α Achernar
- β Cursa
- γ Zaurak
- 40 Keid
- θ Archeman

Gemini — *MITHUNA PUNARVASŪ*
- α Castor
- β Pollux
- γ Alhena — *ĀRDRĀ*

Hercules — *ŚAURĪ*
- α Res Alghetti
- β Kornephoros
- x Marsik

Hydra — *VĀSUKĪ*
- α Alphard — *AŚLEṢĀ*

Leo — *SIṂHA*
- α Regulus — *MAGHĀ*
- β Denebola — *UTTARA PHĀLGUNĪ*
- γ Algeiba
- δ Zosca — *PŪRVA PHĀLGUNĪ*

Lepus — *ŚAŚAKA*
- α Arneb

Libra — *TULĀ*
- α Zubenel Genuti — *VIŚĀKHĀ*
- β Zubenesch
- γ Zuben el Hakrabi

Lyra — *SWARA MAṆDALA*
- α Vega — *ABHIJIT*
- β Sheliak
- γ Sulaphat

Ophiuchus *BHUJAṄGADHĀRĪ*
- α Ras Alhague
- β Kel al Rai
- δ Yed
- ζ Sabik

Orion *MṚGA*
- α Betelgeuse *KĀKŚI*
- β Rigel *RĀJANYA*
- γ Bellatrix
- δ Mintaka
- ε Alnilam
- κ Saiph
- ζ Alnitak

Pegasus *MAHĀŚVA*
- α Markab *PŪRVĀ BHĀDRAPADĀ*
- β Sheat
- γ Algenib *UTTARĀ BHĀDRAPADĀ*
- ε Fom
- ζ Homan

Perseus *YAYĀTI*
- α Mirfak
- β Algol

Pisces *MĪNA*
- α Kaitam
- ζ Piscium

Pisces Austrinus *DAKŚIṆA MATSYA*
- α Fomalhaut *MĪNĀSYA*

Puppis *ARITRA*
- ζ Naos

Sagittarius *DHANU*
- ε Kaus Australis
- δ *PŪRVĀṢĀDHĀ*
- σ *UTTARĀṢĀDHĀ*

Scorpius *VṚŚCIKA*
- α Antares *JYEṢTHĀ*
- β Akrab
- δ Dzuba *ANURĀDHĀ*
- λ Shaula
- ε Scotif *MŪLABARHAṆĪ*

Serpens *BHUJAṄGA*
- α Unukalhay

Taurus *VṚṢABHA*
- α Aldebaran *ROHIṆĪ*
- β El nath
- η Alcyone *KṚTTIKĀ*
- 23 Merope

Ursa Major *SAPTARṢĪ*
- α Dubhe *KRATU*
- β Merak *PULAHA*
- γ Phecda *PULASYA*
- ε Alion *AṄGIRĀ*
- ζ Mizar *VASIṢTHA*
- 80 Alcor *ARUNDHATĪ*
- μ Alcaid

Ursa Minor *DHRUVAMATSYA*
- α Polaris *DHRUVA TĀRĀ*
- β Kochab

Virgo *KANYĀ*
- α Spica *CITRĀ*
- β Zavijava
- γ *ĀPAS*
- ε *Vindemiatrix*

* * *

10

Some Neighbours and Their Distances from Us

Name of the Star		*Distance*	
The Sun	...	8.5	light-minutes
Proxima Centaurus	...	4.3	light-years
Sirius (α in Canis Major)	...	8.7	
Vega (α in Lyra)	...	26	
Capella (α in Auriga)	...	52	
Regulus (α in Leo)	...	67	
Spica (α in Virgo)	...	120	
Betelgeus (α in Orion)	...	200	
Rigel (β in Orion)	...	540	
Deneb (α in Cygnus)	...	650	

* * *

11

Table Showing which Chart to be Used for any Time, any Date and any Month

Month and Date		Hours (I.S.T.) 17 p.m. 5	18 6	19 7	20 8	21 9	22 10	23 11	Hours (I.S.T.) 24/0 a.m. 12/0	1 1	2 2	3 3	4 4	5 5	6 6
January	1	Nov.		Dec.		Jan.		Feb.		Mar.		Apr.		May	
	15		Dec.		Jan.		Feb.		Mar.		Apr.		May		June
February	1	Dec.		Jan.		Feb.		Mar.		Apr.		May		June	
	15		Jan.		Feb.		Mar.		Apr.		May		June		July
March	1	Jan.		Feb.		Mar.		Apr.		May		June		July	
	15		Feb.		Mar.		Apr.		May		June		July		Aug.
April	1	Feb.		Mar.		Apr.		May		June		July		Aug.	
	15		Mar.		Apr.		May		June		July		Aug.		Sept.
May	1	Mar.		Apr.		May		June		July		Aug.		Sept.	
	15		Apr.		May		June		July		Aug.		Sept.		Oct.
June	1	Apr.		May		June		July		Aug.		Sept.		Oct.	
	15		May		June		July		Aug.		Sept.		Oct.		Nov.
July	1	May		June		July		Aug.		Sept.		Oct.		Nov.	
	15		June		July		Aug.		Sept.		Oct.		Nov.		Dec
August	1	June		July		Aug.		Sept.		Oct.		Nov.		Dec.	
	15		July		Aug.		Sept.		Oct.		Nov.		Dec.		Jan.
September	1	July		Aug.		Sept.		Oct.		Nov.		Dec.		Jan.	
	15		Aug.		Sept.		Oct.		Nov.		Dec.		Jan.		Feb.
October	1	Aug.		Sept.		Oct.		Nov.		Dec.		Jan.		Feb.	
	15		Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		Mar.
November	1	Sept.		Oct.		Nov.		Dec.		Jan.		Feb.		Mar.	
	15		Oct		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.
December	1	Oct.		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.	
	15		Nov.		Dec.		Jan.		Feb.		Mar.		Apr.		May

Observer's Latitude 25°N

JANUARY
NORTH
NIGHT-SKY

September	1	at	5	a.m. (I.S.T.)
October	1	at	3	a.m.
December	1	at	1	p.m.
January	**1**	**at**	**9**	**p.m.**
February	1	at	7	p.m.

September	15	at	4	a.m. (I.S.T.)
October	15	at	2	a.m.
December	15	at	10	p.m.
January	**15**	**at**	**8**	**p.m.**
February	15	at	6	p.m.

Auriga (*SĀRATHĪ*)

THE BEAUTIFUL bright star Capella (α in Auriga) appears in the northern sky above the Pole Star at about the same height as the Pole star is above the horizon. It is just above the horizon at about 8 p.m. in October and is near the setting point at about 8 p.m. in May. It can, therefore, be seen almost every night from October to May, after which it is below the horizon during nights. In the month of January, Capella occupies a prominent place in the northern sky and it is situated in the Milky Way.

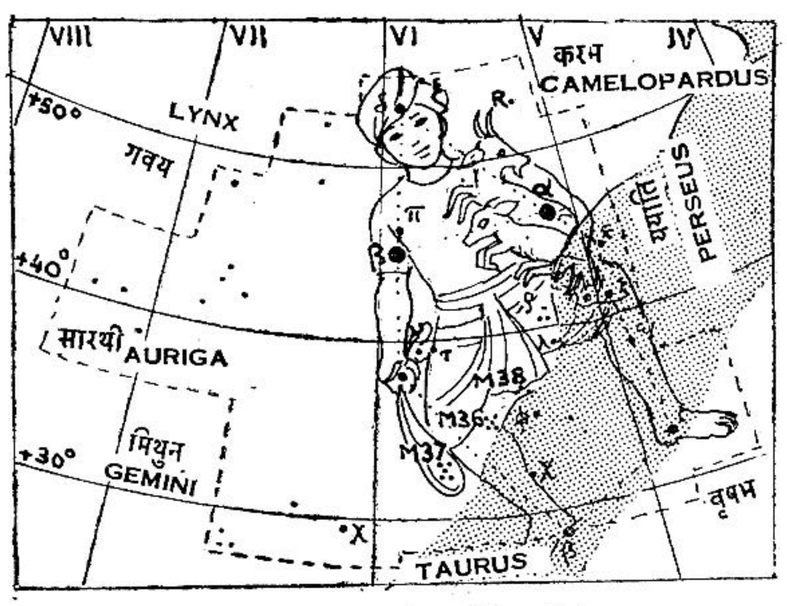

Fig. 1.1. Auriga (Särathī)

Auriga in Greek means the Charioteer, but in most star maps the constellation is shown as a huge man carrying a goat and two kids. According to Grecian legends, Auriga was a chariot-driver, identified with the son of god Vulcan. This son was suffering from a physical deformity and, therefore, he had invented the four-horse chariot so that he could travel from place to place. Jupiter rewarded him with a constellation and chose for that purpose five bright stars somewhat resembling an ancient chariot. In the star maps, the goat which the charioteer holds, according to one tradition, was the goat on whose milk infant Jupiter was fed. The story further says that while playing with the goat, Jupiter accidentally broke off one of its horns. The brilliant star Capella represents that horn of the goat. This star has always been connected with the shepherds by the Greeks and ancient Romans. Capella is referred to, in English poetry, as the Shepherd's star.

The star β, on the southern side of the Milky Way, used to be included in Auriga; but it really forms part of Taurus. In the pictorial representation, this star occupies the tip of the left horn of the Bull. Auriga is thus now only shown as a four-sided figure, instead of five-sided.

Capella is known as *BRAHMAHṚDAYA* (ब्रह्महृदय) in Indian astronomy. It is a beautiful double, consisting of two great suns of nearly equal brilliance. These two stars lie so close together that between them there is not more than half the distance between the earth and the sun. These two stars revolve about their common centre of gravity in only 104.2 days. Each of these big stars has a small partner, thus making Capella a quadruple star.

The distance of Capella from the earth is estimated at about 34 light-years. A light-year is the distance that light travels in one year with a speed of 300,000 km. per second.

The star β (Menkalinan), called *AGNI* (अग्नि) in Indian astronomy, is of magnitude 2.1 and it is a spectroscopic binary. Each of these components is about 160 light-years away from us and each of them possesses a mass almost 2½ times the mass of the sun. The components can only be resolved with the help of a spectroscope, hence its description as a spectroscopic binary.

The star ε in Auriga is an eclipsing binary. In this kind of a double star, the components alternately eclipse one another. This becomes possible because their orbital planes are in line with the earth. One of the partners is blue in colour, about 100 times brighter than the sun. Its mass is 9 times and size about 3.5 times greater than the sun.

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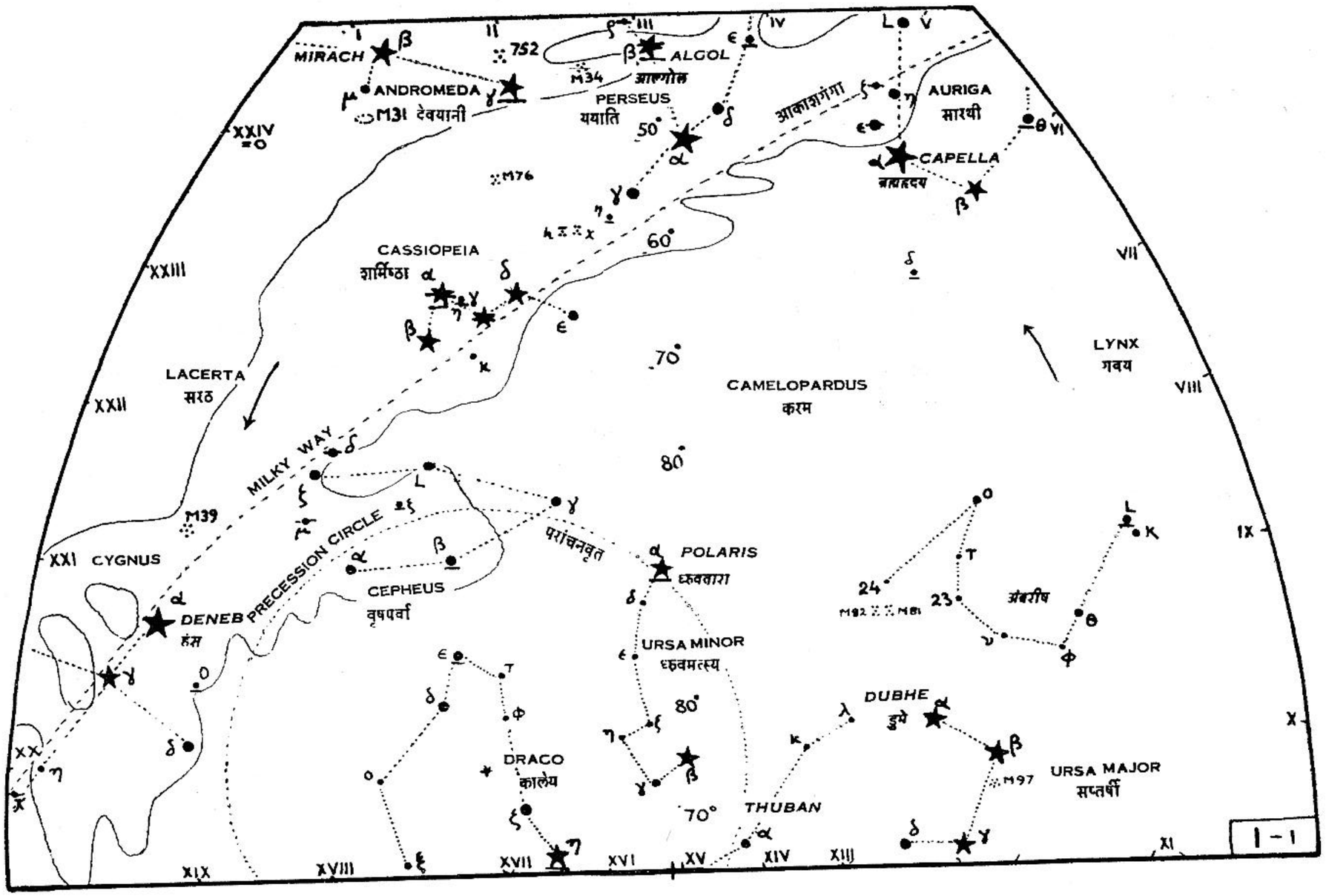

Observer's Latitude 25°N

JANUARY NORTH KEY-MAP

September	1	at	5	a.m. (I.S.T.)
October	1	at	3	a.m.
December	1	at	11	p.m.
January	**1**	**at**	**9**	**p.m.**
February	1	at	7	p.m.

September	15	at	4	a.m. (I.S.T.)
October	15	at	2	a.m.
December	15	at	10	p.m.
January	**15**	**at**	**8**	**p.m.**
February	15	at	6	p.m.

JANUARY : NORTHERN SKY

Prominent Stars :

β in Andromeda (Mirach)
α in Auriga (Capella)
β in Cassiopeia (Caph) lies near hour-angle 0.
α in Cygnus (Deneb)
β in Perseus (Algol)
α, β in Ursa Major (Dubhe, Merek)
α in Ursa Minor (Polaris). Present Pole Star

Double Stars :

γ in Andromeda, seen with a small telescope. Has blue and yellow partners.
η in Cassiopeia, seen with a 5 cms. telescope. Period of revolution 526 years.
β, ξ in Cepheus, seen with a 5 cms. telescope.
β in Perseus (Algol). This is an eclipsing binary and it has two more companions, making it a quadruple star.
ε, ζ, η in Perseus, seen with a 5 cms. telescope.
α in Ursa Minor (Polaris), wide double 18" apart. Difference of brightness is 7 magnitudes, seen with a 5 cms. telescope.

Variable Stars :

α in Cassiopeia varies from magnitude 2.2 to 2.8
δ in Cepheus, period 5.37 days.
μ in Cepheus, red and of irregular period.
β in Perseus (Algol), with a period of 2 days 20 hours and 49 minutes.
ρ in Perseus, irregularly variable.

Supernova :

This had appeared in Cassiopeia in A. D. 1572 and at some time it appeared as bright as Venus.

Nebulae and Star Clusters :

M 31 (NGC 224) in Andromeda is visible to naked eyes. It is an independent galaxy and is our nearest neighbour.
Distance = 500,000 parsecs = 1,600,000 light-years.
NGC 752 in Andromeda near star γ. Large and open.

* * *

Star-Studded Portions of the Night-Sky

BELOW ARE two photographic views of different portions of a night-sky. These represent regions of high and low star density and they are portions of the common appearance known as the Milky Way (Fig. 1.2). In some of these regions, we find older stars as well as younger stars. In other regions, where the density is less, there are huge collections of gas and dust where new stars are being formed. (See also : Milky Way on page 33).

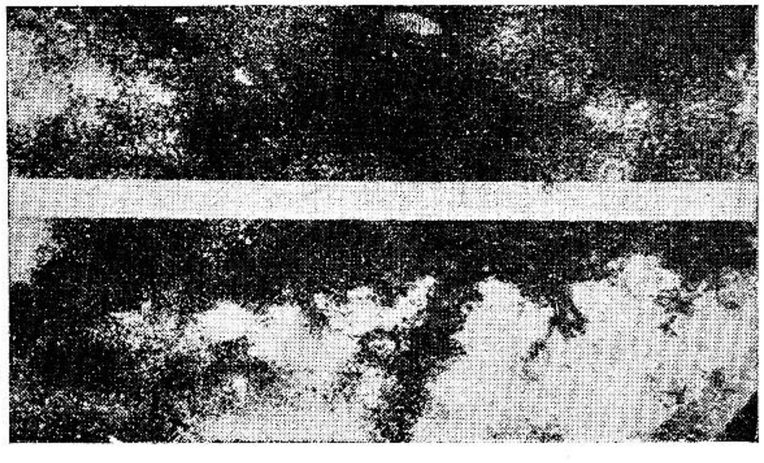

Fig. 1.2 : Parts of Milky Way

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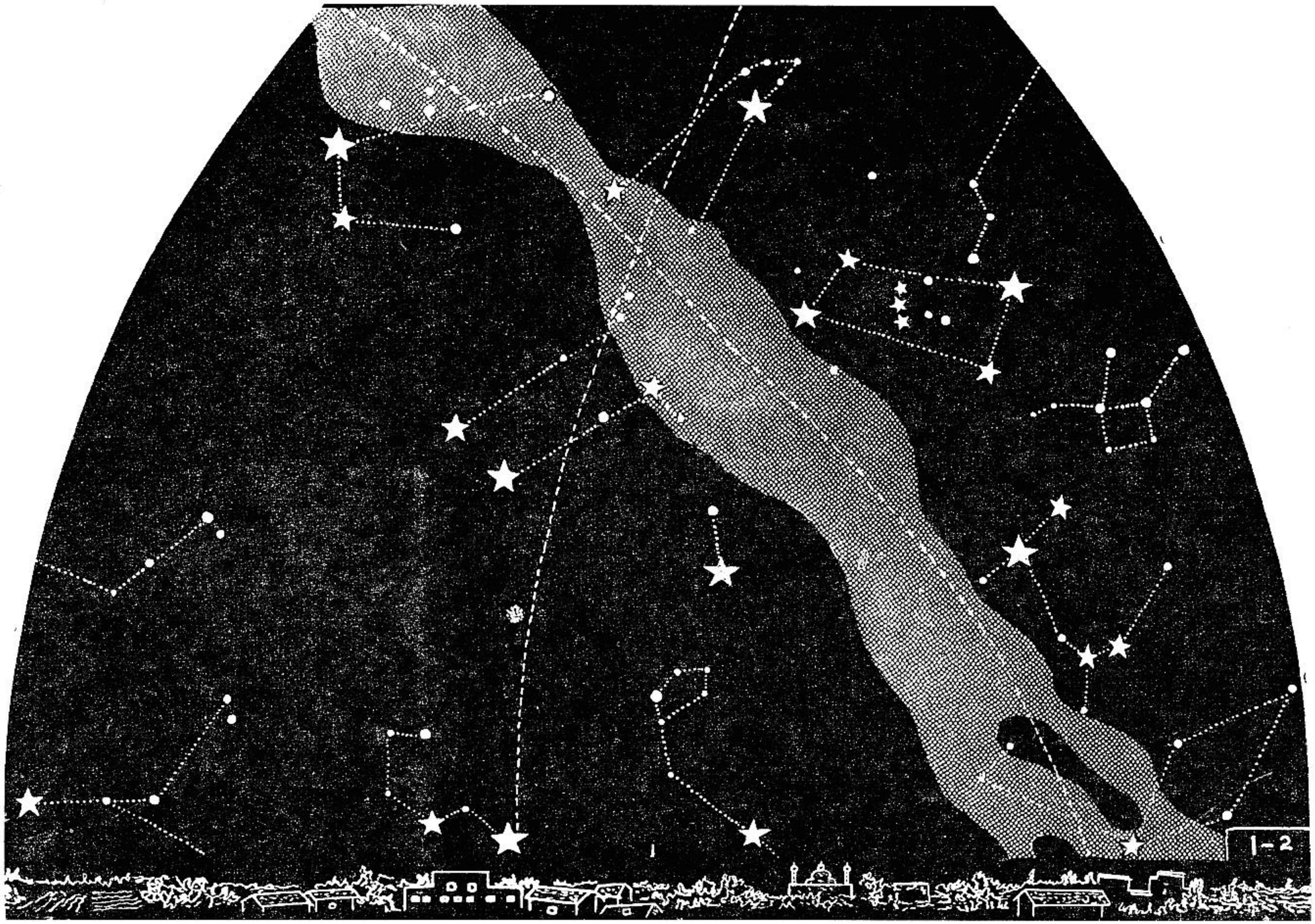


Observer's Latitude : 25° N

JANUARY
EAST
NIGHT-SKY

September	1	at	5	a. m. (I.S.T.)	September	15	at	4	a. m. (I.S.T.)
October	1	at	3	a. m.	October	15	at	2	a. m.
December	1	at	11	p. m.	December	15	at	10	p. m.
January	**1**	**at**	**9**	**p. m.**	**January**	**15**	**at**	**8**	**a. m.**
February	1	at	7	p. m.	February	15	at	6	p. m.

Taurus (*VṚṢABHA*)

ACCORDING TO Indian astronomy, Pleiades (*KṚTTIKĀ* कृत्तिका), Hyades (*ROHIṆĪ* रोहिणी) and nearly half of Orion (*MṚGA* मृग) form part of the Zodiacal sign *VṚṢABHA* (वृषभ) or Taurus the Bull. But according to the westerns, the Taurus includes Pleiades and Hyades, and the star β (Nath) which was formerly regarded as part of the constellation Auriga. Orion is treated as a separate constellation.

The Bull occupies a very prominent place in most ancient cultures. Mohenjodaro represents a civilization prior to the Vedas. A horse with a horn, an elephant and a bull were common pictures in old times. Coins carried an impression of a bull. Among Lingayats, the bull is regarded, (as in fig.1.3), an incarnation of God.

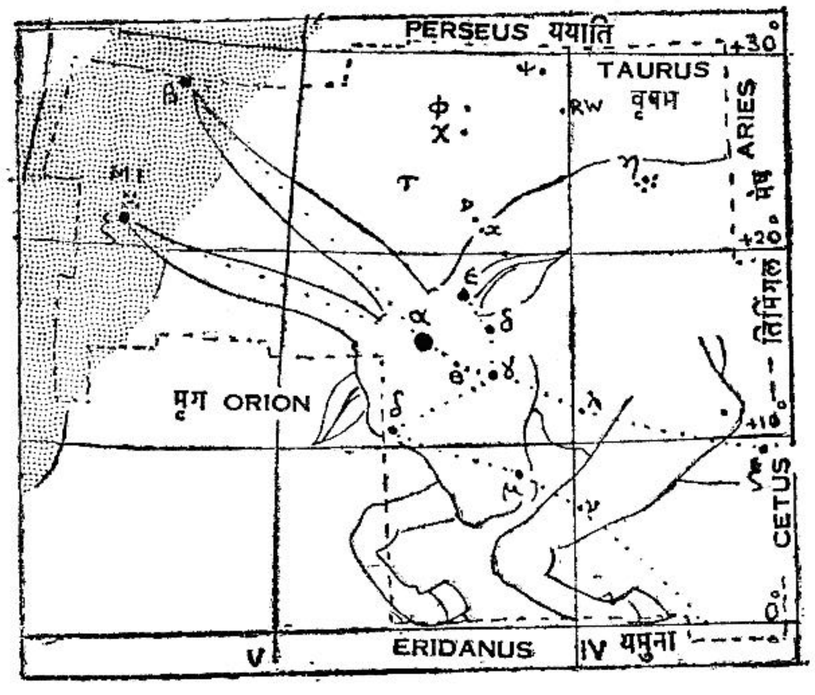


Fig. 1.3 Taurus (Vṛṣabha)

According to the Chaldeans, this costellation representing "an illuminated bull" collides against the sun and causes the onset of the spring. It is now known that the Vernal Equinnox was actually in Taurus in the ancient times from 4550 B.C. to 1850 B.C. At about that time the Golden Bull was regarded as a Goddess by the Egyptians.

According to Greek mythology, Jupiter, the great ruler of Olympus, once changed himself into a snow-white bull and desired to carry off Europa, princess of Phoenicia. With this object in view, he entered the cattle shed of Europa's father. When the princess happened to look at this Bull, she was fascinated by its appearance. She caressed it and finally climbed upon its back. As soon as the Bull saw that it had secured its prize, it gathered speed, ran to the sea and swam to the island of Crete. The figure of the constellation Taurus is, therefore, depicted as a swimming bull with only its head out of water.

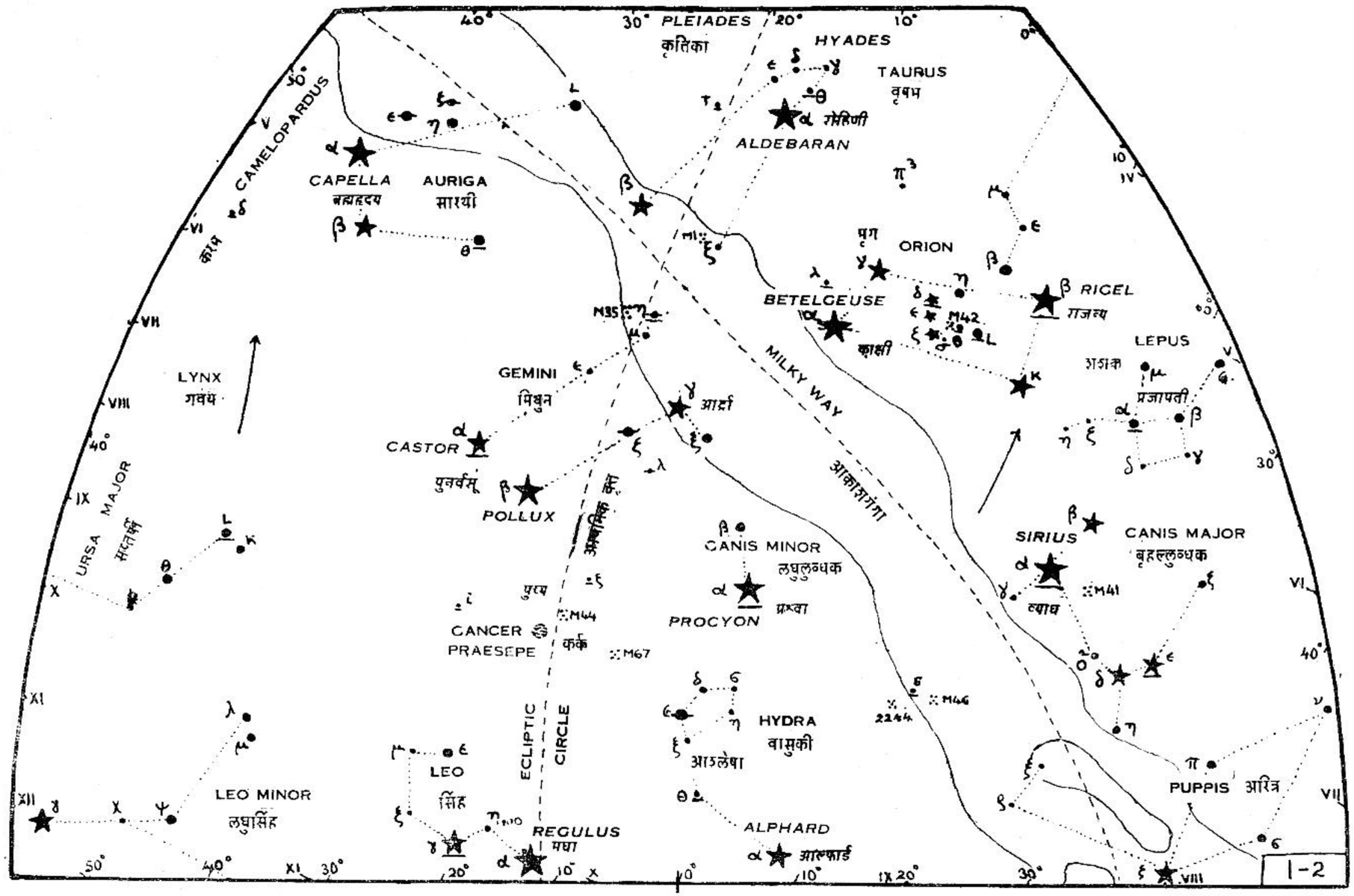
In the pictorial representation (fig. 1.3), Hyades is usually shown to occupy the forehead of the bull and Pleiades are shown near its back.

(For Hyades, see page 23. For Pleiades, see page 31.)

The constellation Taurus includes two open star clusters, now know as the Pleiades and the Hyades in which various individual stars are visible even with naked eyes.

There is a radio source in Taurus A, which coincides with the Crab Nebula M 1, near the tip of the right horn of the bull. Chinese and Japanese annals record the appearance of a Super Nova iu this part of the sky in the year 1054 A. D. M 1 is considered to be the remains of the star that exploded then.

* * *



Observer's Latitude : 25° N

JANUARY
EAST
KEY - MAP

September	1	at	5 a. m.	(I.S.T.)
October	1	at	3 a. m.	
December	1	at	11 p. m.	
January	**1**	**at**	**9 p. m.**	
February	1	at	7 p. m.	

September	15	at	4 a. m.	(I.S.T.)
October	15	at	2 a. m.	
December	15	at	10 p. m.	
January	**15**	**at**	**8 p. m.**	
February	15	at	6 p. m.	

JANUARY, EASTERN SKY

Prominent Stars :

- α in Auriga (Capella).
- α in Canis Major (Sirius).
- α in Canis Minor (Procyon).
- α and β in Gemini (Castor and Pollux).
- α in Hydra (Alphard).
- α in Leo (Regulus) lies exactly on the Ecliptic.
- α and β in Orion (Betelgeuse and Rigel).
- α in Taurus-Hyades (Aldebaran).

Double Stars :

- α in Canis Major (Sirius). Brightest among the visible stars. Its companion is a white dwarf with a difference in magnitude of 10.
- α in Canis Minor. This is a very bright star, but its companion is a white dwarf and faint.
- α in Gemini (Castor), seen with a 5 cms. telescope. This is a sextuplet. The principal two components have a period of revolution of 380 years. The others are spectroscopic binaries.
- α in Leo (Regulus) is triple.
- γ in Leo is a double star. It can be seen with a 5 cms. telescope.
- θ_1, θ_2, δ in Orion, seen with a binocular.
- θ_1 in Orion is a quadruplet and can be seen with a 5 cms. telescope.
- θ in Taurus (Hyades) is visible to naked eyes.
- ι in Taurus, seen with binoculars, near the base of the triangle.

Variable Stars :

- ε and ζ in Auriga are eclipsing variables with periods of 9883 and 972 days, visible to naked eyes.
- ζ and η in Gemini.
- α in Orion, irregularly variable.

Nebulae and Star Clusters :

M 44 near δ in Cancer (Praesepe), visible to naked eyes.

M 67 (NGC 2682) near α in Cancer, faintly visible through binoculars.

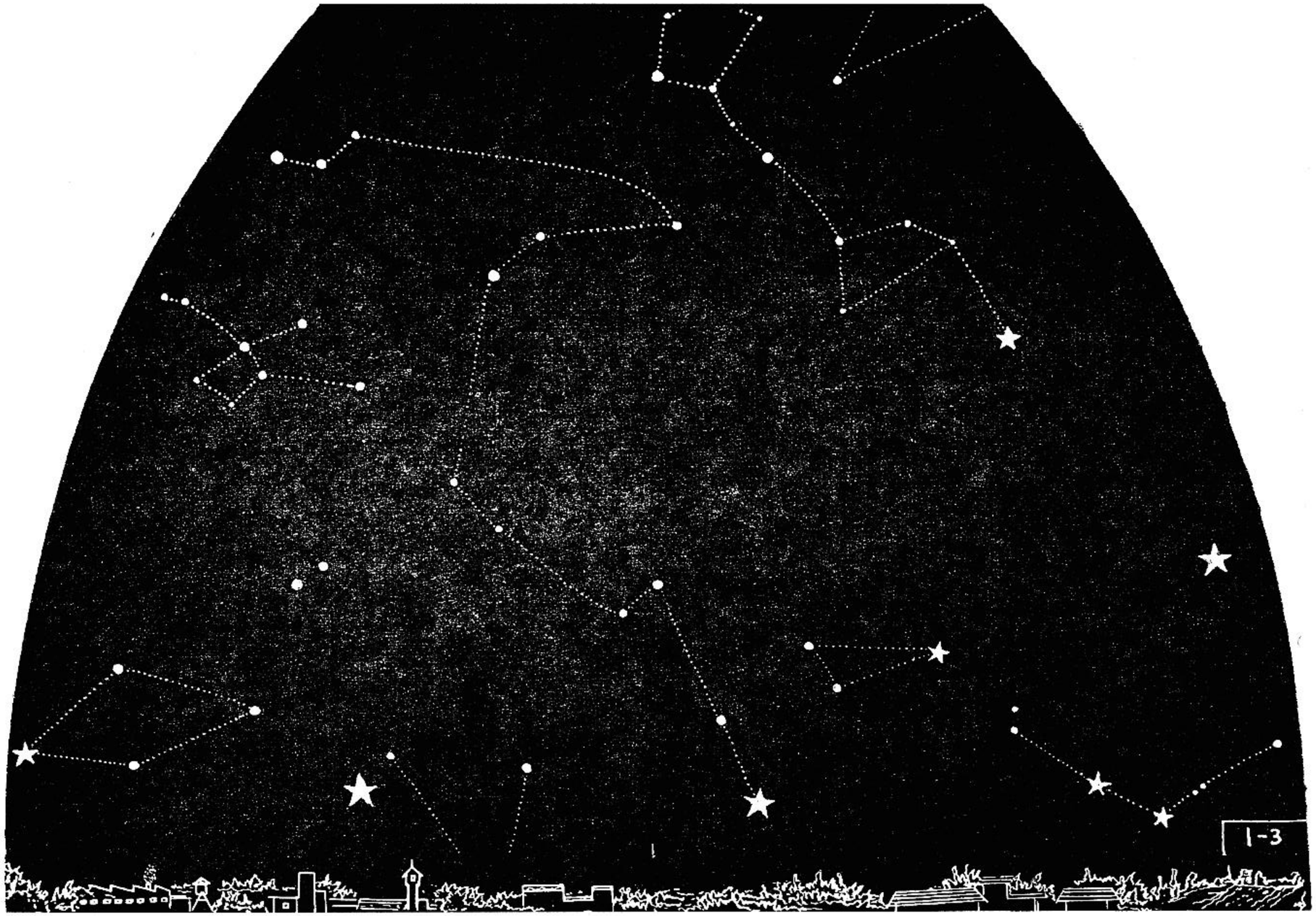
M 41 (NGC 2287) about 5° below α in Canis Major, visible to naked eyes.

M 35 (NGC 2168) in Gemini, visible to naked eyes. This contains about 120 stars.

M 42 (NGC 1976) in Orion. This is known as the Great Orion Nebula and is situated below σ in the belt.
Distance = 400 parsecs = 1300 light-years.
Diameter = 30 parsecs = 100 light-years.

M 46 (NGC 2437) and NGC 2422 in Puppis are two beautiful clusters. They are almost on the same celestial latitude as Sirius and can be seen with field glasses.

* * *



Observer's Latitude : 25° N

JANUARY
SOUTH
NIGHT-SKY

September	1	at 5	a. m.	(I.S.T.)
October	1	at 3	a. m.	
December	1	at 11	p. m.	
January	**1**	**at 9**	**p. m.**	
February	1	at 7	p. m.	

September	15	at 4	a, m.	(I.S.T.)
October	15	at 2	a. m.	
December	15	at 10	p. m.	
January	**15**	**at 8**	**p. m.**	
February	15	at 6	p. m.	

Hyades (*ROHIṆĪ*)

THE HYADES are a part of the constellation Taurus, but by themselves, they from a group of stars moving with a common velocity through space.

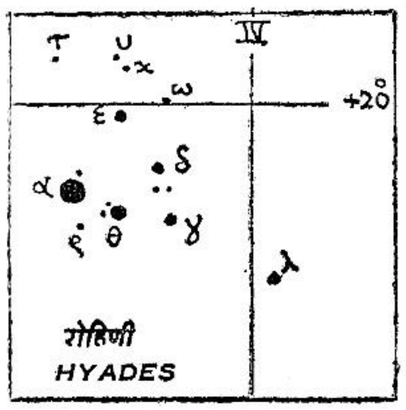


Fig. 1.4 Hyades (Rohiṇī)

The configuration of five stars, including α, is called Hyades. In reality this is a group of more than 150 stars and it belongs to our galaxy, the Milky Way.

The principal stars of the group are α, θ, γ, δ and ε. They form an isosceles triangle with the brightest α (Aldebaran) in the base.

θ is a wide double seen with naked eyes.

τ is a double seen with field glasses. It lies beyond the base of the isosceles triangle.

According to Indian mythology, the star Aldebaran is *ROHIṆĪ* (रोहिणी) and there is an ancient legend connecting *ROHIṆĪ*, Orion the Stag and Sirius the Hunter. *PRAJĀPATI* (प्रजापति) once got enamoured of the charms of a young and beautiful girl and desired to possess her. She, however, got scared and ran away. *PRAJĀPATĪ* attempted to chase her in the garb of an antelope (*MṚGA* मृग). Gods did not like the situation. Therefore they created a warrior who ultimately killed the antelope with an arrow. This warrior was *VYĀDHA* (व्याध), the Hunter Sirius. The arrow is seen inside the Orion, when pictured as the Antelope. The name of the girl was *ROHIṆĪ*.

Aldebaran is a red star of magnitude 1.6. Its surface temperature is about 3000°C and it has a companion. The diameter of Aldebaran is about 51.2 million Km., which is about 37 times larger than the sun.

Precession is the movement which is visible in the change of position of the North Celestial Pole and the movement is accompanied by a shift in the Vernal and Autumnal Equinoxes (see pages 51 and 179). Because of the precession, the Vernal Equinox has moved slowly backwards, along the Ecliptic, until today the zodiac signs are about 30° zone behind the constellation of that name.

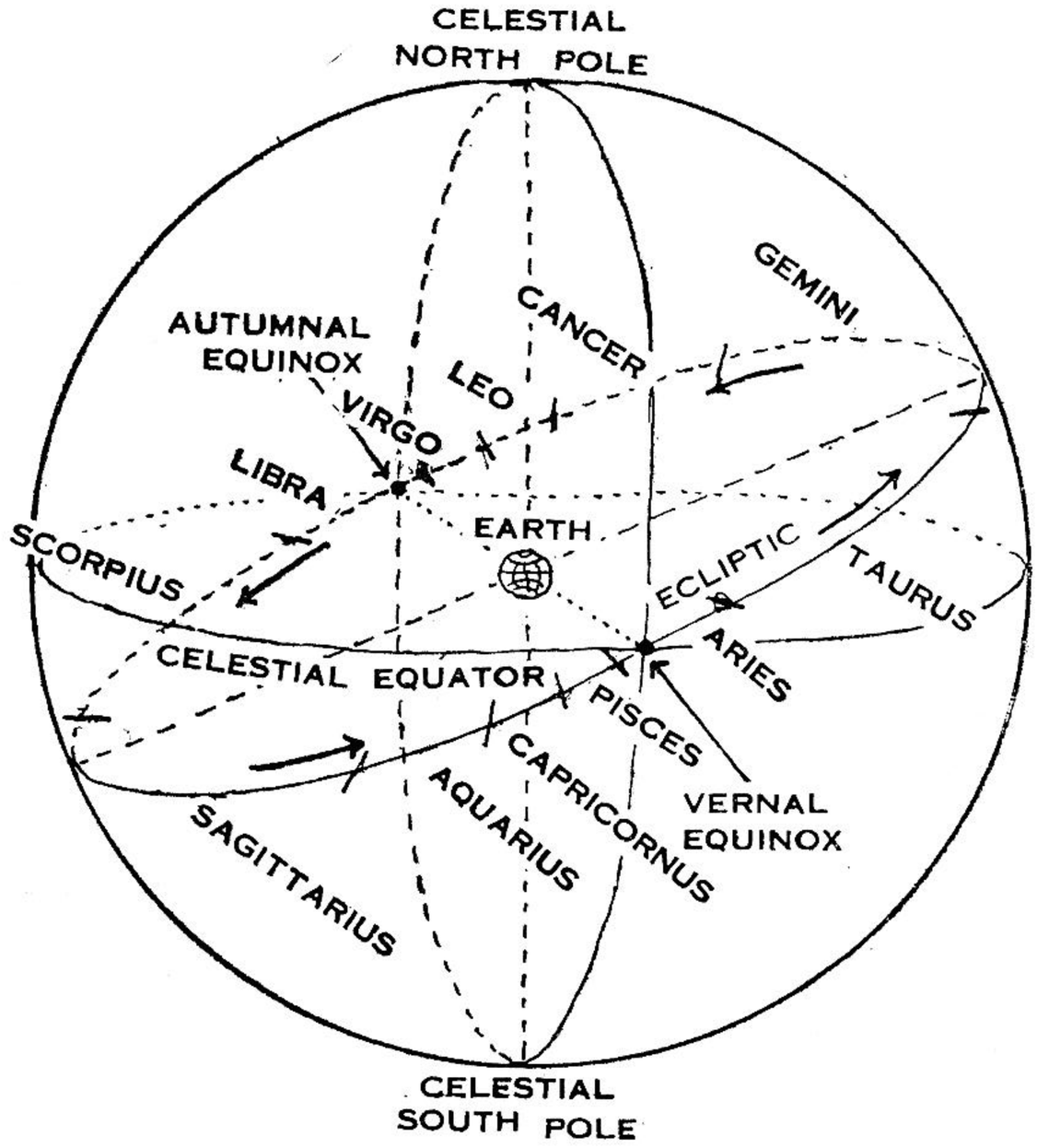
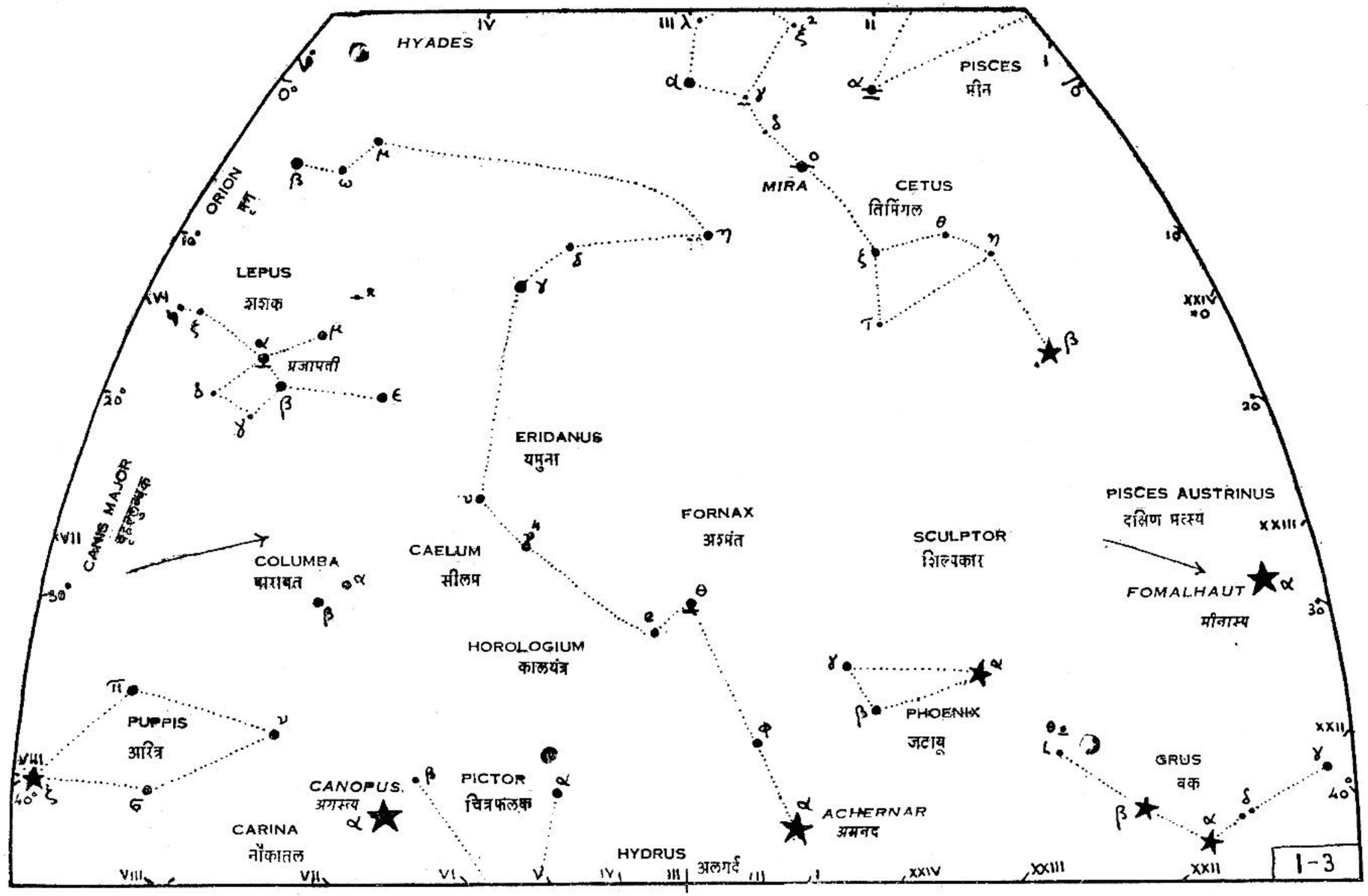


Fig. 1.5 Precession of Equinoxes

(Continued on Page 25 Col. 2)



Observer's Latitude : 25° N

September	1	at	5	a. m. (I.S.T.)		September	15	at	4	a. m. (I.S.T.)
October	1	at	3	a. m.		October	15	at	2	a. m.
December	1	at	11	p. m.		December	15	at	10	p. m.
January	**1**	**at**	**9**	**p. m.**		**January**	**15**	**at**	**8**	**p. m.**
February	1	at	7	p. m.		February	15	at	6	p. m.

JANUARY
SOUTH
KEY - MAP

JANUARY : SOUTHERN SKY

Prominent Stars :

- α in Carina, in former Argo Navis, (Canopus).
- α in Cetus (Mira).
- α in Eridanus (Achernar).
- α, β in Grus.
- α in Phoenix.
- α in Pisces Austrinus (Fomalhaut).

Double Stars :

- θ in Eridanus, magnitudes 3 and 5.25. This star was formerly called Achernar. Now it is known as Ekamer.
- θ in Grus, near L.
- α in Lepus, companions of magnitudes 4.0 and 9.5. 35″.5 apart.
- α in Pisces, pale green and blue pair. A test for a 5 cms. telescope.
- β in Pisces Austrinus. Companions of magnitudes 4.4 and 7.8. 30″ apart.

Variable Stars :

- o in Cetus (Mira). This was the first discovered variable in 1596 A. D. It has a period of 332 days. The brightness, changes by a factor of 2100.

* * *

HYADES (Continued from Page 23)

About the year 3000 B. C. the Vernal Equinox used to be in Taurus. The four stars, Aldebaran (α in Taurus), Regulus (α in Leo), Antares (α in Scorpius) and Fomalhaut (α in Pisces Austrinus) were described by the Persians as Royal Stars, because they marked the Vernal Equinox, the Summer Solstice, the Autumn Equinox and the Winter Solstice respectively about the period 2700 B. C.

* * *

Triangulum (*UTTARA TRIKOṆA*)

LOOKING TOWARDS the western sky (see maps on pages 26 and 28) we see Andromeda in the right-hand top corner. Near Andromeda, but further away from the Milky Way, we see a long and slim triangle-shaped figure. This is known as Triangulum. The stars are of magnitudes 3 and 4. On the western side of the constellation, to the right of α, there is a beautiful Spiral Nebula called M 33. Under good conditions, the nebula can be observed with a small telescope. This nebula happens to be one of the nearest galaxies.

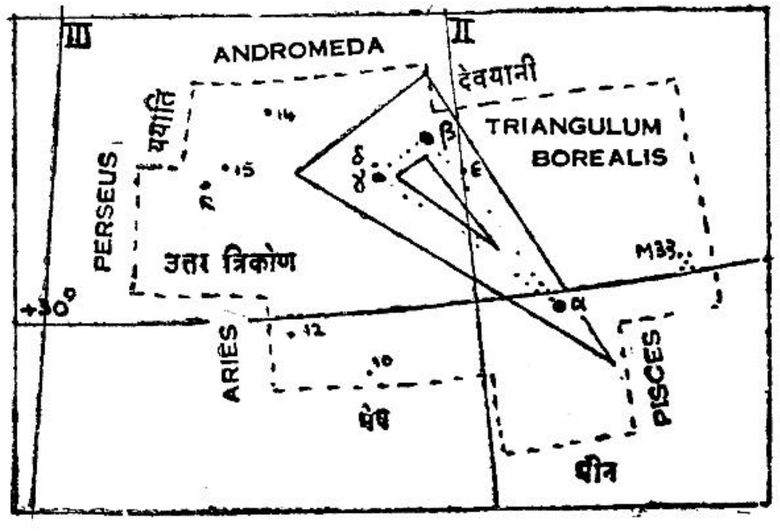


Fig. 1.6 Triangulum Borealis. (Uttara Trikoṇa)

* * *

Observer's Latitude : 25° N

JANUARY
WEST
NIGHT - SKY

September	1	at	5	a. m. (I.S.T.)
October	1	at	3	a. m.
December	1	at	11	p. m.
January	**1**	**at**	**9**	**p. m.**
February	1	at	7	p. m.

September	15	at	4	a.m. (I.S.T.)
October	15	at	2	a.m.
December	15	at	10	p.m.
January	**15**	**at**	**8**	**p.m.**
February	15	at	6	p.m.

Cetus (*TIMIṄGALA*)

CETUS MEANS the Whale. The constellation is behind Aquarius and wholly below the Ecliptic, which is the Sun's apparent path among the stars. In the winter months, the position of Aquarius is below Pisces and thus it can be easily located.

According to the Chaldeans, Cetus was the Goddess of confusion and disorder. In Greek literature, Cetus was a ferrocious Sea Monster that infested the seas, loitered near the shores and the mouths of rivers, destroying every man and animal that came within its reach. The legend states that, obeying the dictates of an oracle, King Cepheus had kept his own daughter Andromeda tied up to a rock on the shore so that she may be devoured by the monster and the whole township should be, thereby, saved from its fury. Perseus is mentioned as having destroyed the monster and exposed it to the horrible head of Medusa which he was carrying with him in his hand.

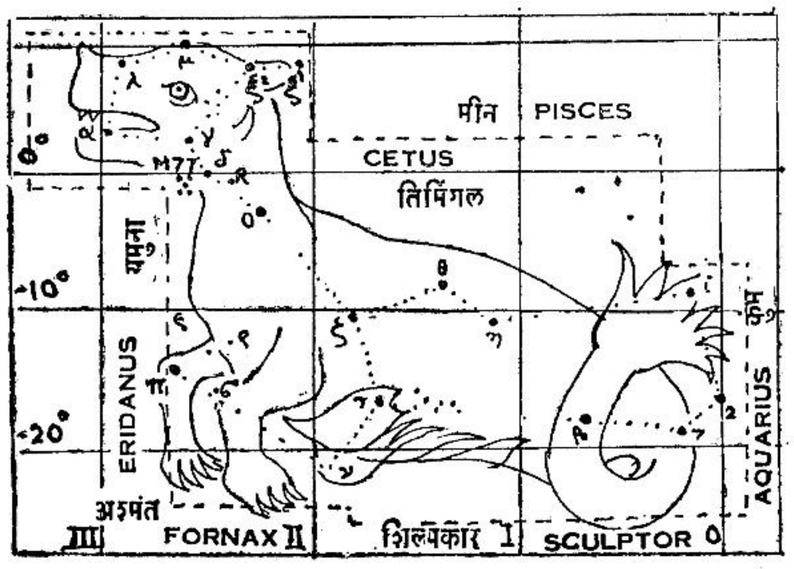


Fig. 1.7 Cetus. (Timiṅgala)

The monster was turned into a stone and then it went to the bottom of the sea.

The picture, made by drawing lines through the bright stars of the constellation, does, indeed, resemble any one of the ferrocious prehistoric reptiles of enormous size, now known as Dinosaure and believed to have been roaming about the earth and the seas during the Mesozoic Age.

The constellation Cetus is visible during the winter months and it occupies over 40° of the sky. The animal's head is almost pentagonal as made up by the stars α, λ, μ, ξ^2 and γ in this region. Its neck is very long and above the celestial equator. The tail is longer than the neck and is turned upwards, suggesting the angry mood of the animal. The outline is enough to suggest the kind of animal that it is imagined to represent.

Cetus is below Orion and far below Andromeda. The V-shaped Hyades in Taurus, containing Aldebaran, direct our eye to the monster's head extending towards the east. Prominent stars and their names are α (Menkar), β (Diphda) and o (Mira). The star α forms the head and the star β forms the tail of the monster.

The most amazing object in this constellation is the star o in its neck. Its name is Mira. Written as Myra, it means the Wonderful. The star has the wonderful property of changing its brightness in a period of 11 months. For six months Mira remains visible to the naked eye. During the remaining five months it can be seen only with a powerful telescope. The brightness changes through about 2100 times, and the change is quite unmistakable. The cause of this large increase in its brightness, periodically, is supposed to be the outburst of hydrogen gas. The star is about 23 light-years distant from us. About one quarter of all variable stars show the same type of light variation as Mira.

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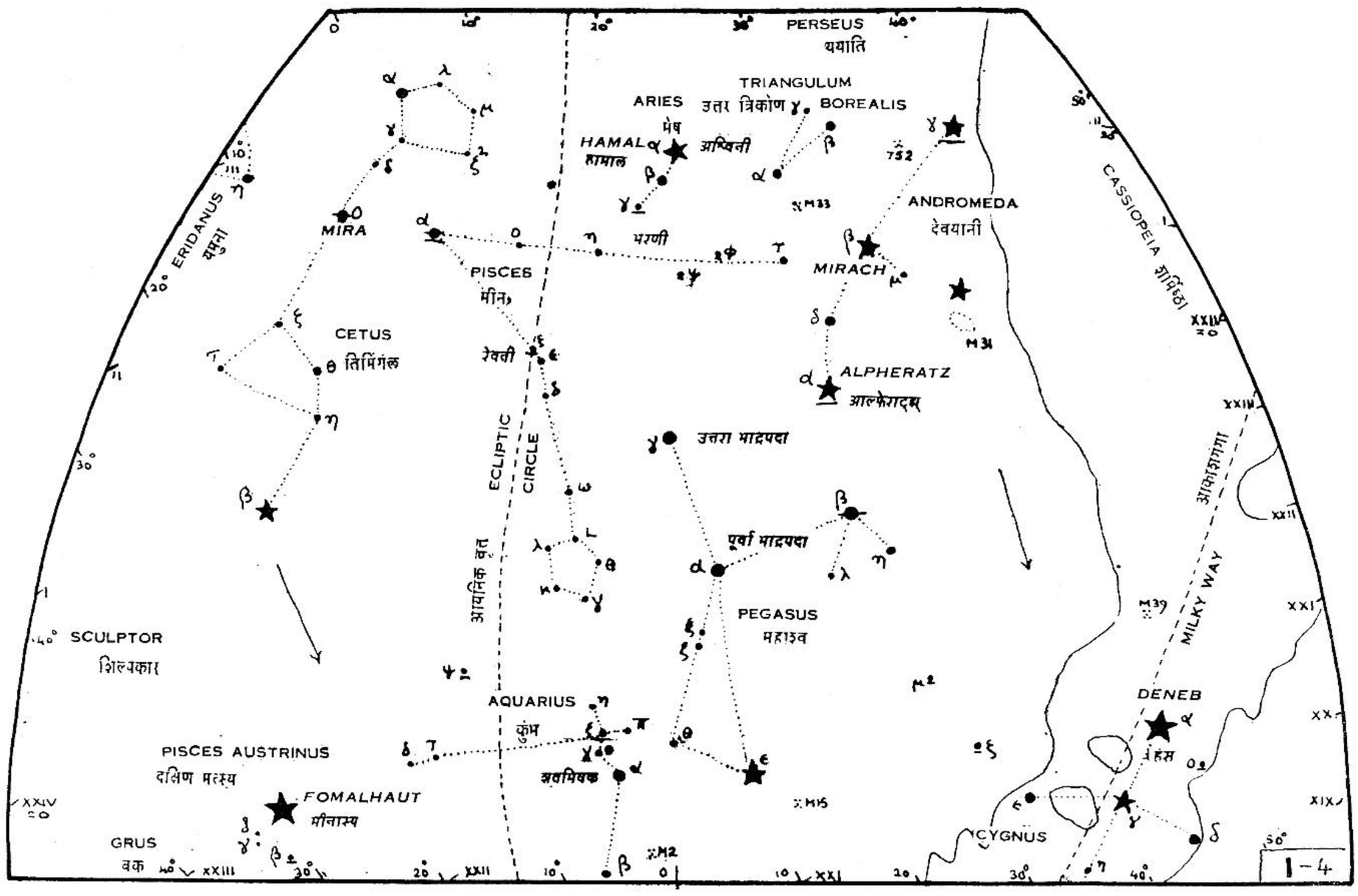

Observer's Latitude 25° N

September	1	at	5 a. m. (I.S.T.)
October	1	at	3 a. m.
December	1	at	11 p. m.
January	**1**	**at**	**9 p. m.**
February	1	at	7 p. m.

JANUARY
WEST
KEY - MAP

September	15	at	4 a. m. (I.S.T.)
October	15	at	2 a. m.
December	15	at	10 p. m.
January	**15**	**at**	**8 p. m.**
February	15	at	6 p. m.

JANUARY : WESTERN SKY

Prominent Stars :

α, β, γ in Andromeda (Alpheratz, Mirach, Almach).
α in Aries (Hamal).
o in Cetus (Mira).
α, β, γ in Pegasus (Markab, Sheat, Algenib).
α in Pisces Austrinus (Fomalhaut).

Double Stars :

γ in Andromeda, attractive double, seen through a small telescope. Components are faint blue and bright yellow.
γ in Aries seen with a 5 cms. telescope.
α, ϕ in Pisces. These can be seen only with a large telescope.
ψ, ζ in Pisces, easily seen doublets.

Variable Stars :

o in Cetus (Mira), with a period of 332 days, Its brightness changes by a factor of 2100.
β in Pegasus (Sheat).

Nebulae and Star Clusters :

M 31 (NGC 224) in Andromeda, beyond β and μ. Appears like a cloud seen with naked eyes. It is an independent nearest galaxy.
Distance = 500,000 parsecs = 1,600,000 light-years.
NGC 752 near γ in Andromeda. Large and open.
M 2 (NGC 7089) in Aquarius, seen with a small field-glass.
M 15 (NGC 7078) near ε in Pegasus. Globular and brilliant.
M 33 (NGC 598) near α in Triangulum. This is a Spiral Nebula and can be seen with a small telescope. This is one of the nearest galaxies.

* * *

Pictor (*CITRA PHALAKA*)

THE NOMENCLATURE is modern and it means the Painter. This is a southern hemisphere constellation, situated between −43°S and −64°S Declination. During the months of January, February, March and April, it is just visible above the horizon in the southern sky to observers in Lat. 25°N.

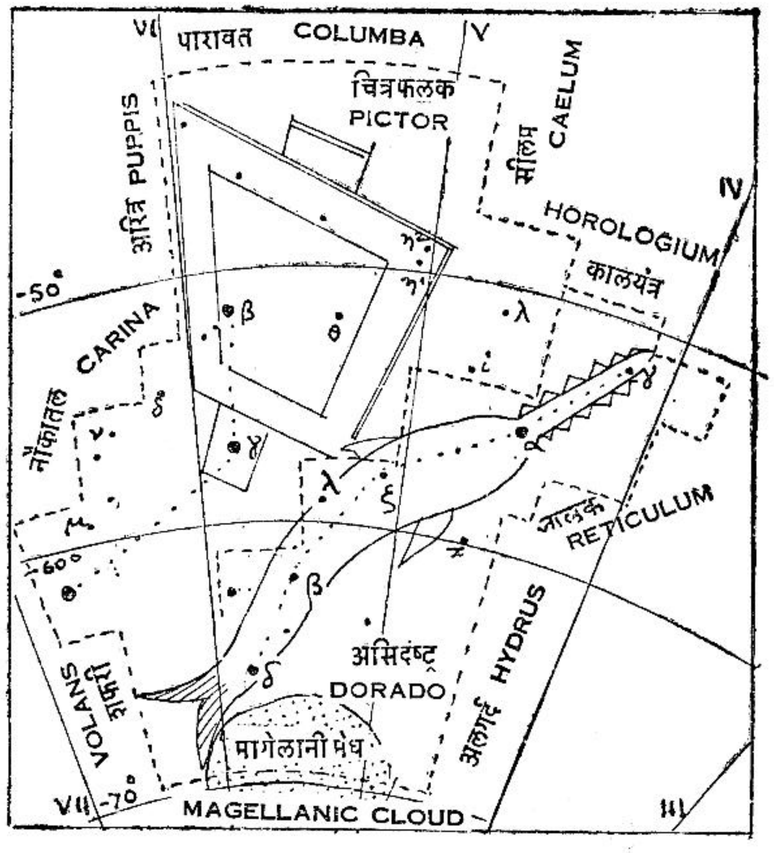

Fig. 1.8 Pictor (Citra Phalaka)

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Observer's Latitude : 25° N

JANUARY ZENITH NIGHT-SKY

September	1	at	5	a. m. (I.S.T.)
October	1	at	3	a. m.
December	1	at	11	p. m.
January	**1**	**at**	**9**	**p. m.**
February	1	at	7	p. m.

September	15	at	4	a. m. (I.S.T.)
October	15	at	2	a. m.
December	15	at	10	p. m.
January	**15**	**at**	**8**	**p. m.**
February	15	at	6	p. m.

Pleiades (*KṚTTIKĀ*)

THE PLEIADES are almost overhead in the night sky in this month. They represent a very interesting group of stars that can be seen from almost every civilized country in the world. There are, therefore, many legends connected about them. Formerly seven stars could be clearly distinguished in this group, but now only six prominent stars can be seen. These stars form the figure of a short handled dipper. The pictorial representations of Ursa Major and Ursa Minor are, according to some, made to indicate the Great Dipper and the Small Dipper respectively.

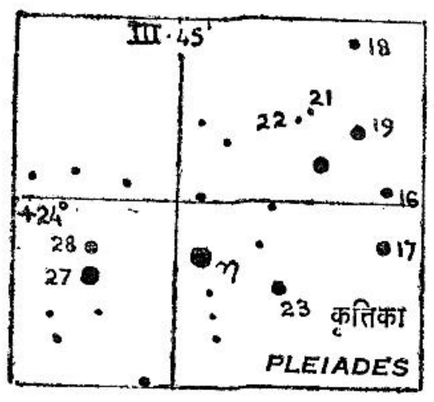


Fig. 1.9 Pleiades (Kṛttikā)

According to Greak Mythology, the Pleiades (*KṚTTIKĀ*) are seven daughters of Atlas and Pleione. They are thus called the Seven Sisters. Seen through a telescope, the group is known to consist of more than 300 stars and the whole area is entangled in a nebulous region. Almost each star has its separate nebula about it and thus it appears like a bright pearl kept in white cotton wool.

There is another legend in Greek mythology. Atlas was the name of the father and the names of the seven sisters were as follows :- (1) Alcyone (2) Merope (3) Celaeno (4) Electra (5) Sterope (6) Tayagata and (7) Maia. God had sent Atlas to the skies to support the universe. [In our present day Atlas-books (map books) we do find the picture of the strongly built Atlas supporting the world on his shoulders.] The seven sisters were very much grieved by the loss of their father, but with a view to mitigate their loss, all the seven sisters were given a place in the heaven and they thus became the Constellation Pleiades.

The Pleiades are mentioned in Vedic literature as being seven. In Indian mythology, *KĀRTIKA SVĀMĪ* (कार्तिक स्वामी) was born of six mothers and thus the name *ṢAṆMĀTURA* (षण्मातुर), having six mothers. This anecdote also accounts for the six heads of *KĀRTIKA SVĀMĪ* as the contributions from the six mothers.

There is another ancedote, mentioned in Indian mythology. The seven stars in Pleiades represent the seven wives of the seven sages in the constellation *SAPTARṢĪ* (Ursa Major or the Great Bear) and the names of the wives, as given in ancient literature, are : *AMBĀ* (अम्बा), *DULĀ* (दुला), *VITANĪ* (वितनी), *ABHRAYANTĪ* (अभ्रयंती), *MEGHADANTĪ* (मेघदन्ती), *VARṢAYANTI* (वर्षयंती), and *CUPUṆIKĀ* (चुपुणिका).

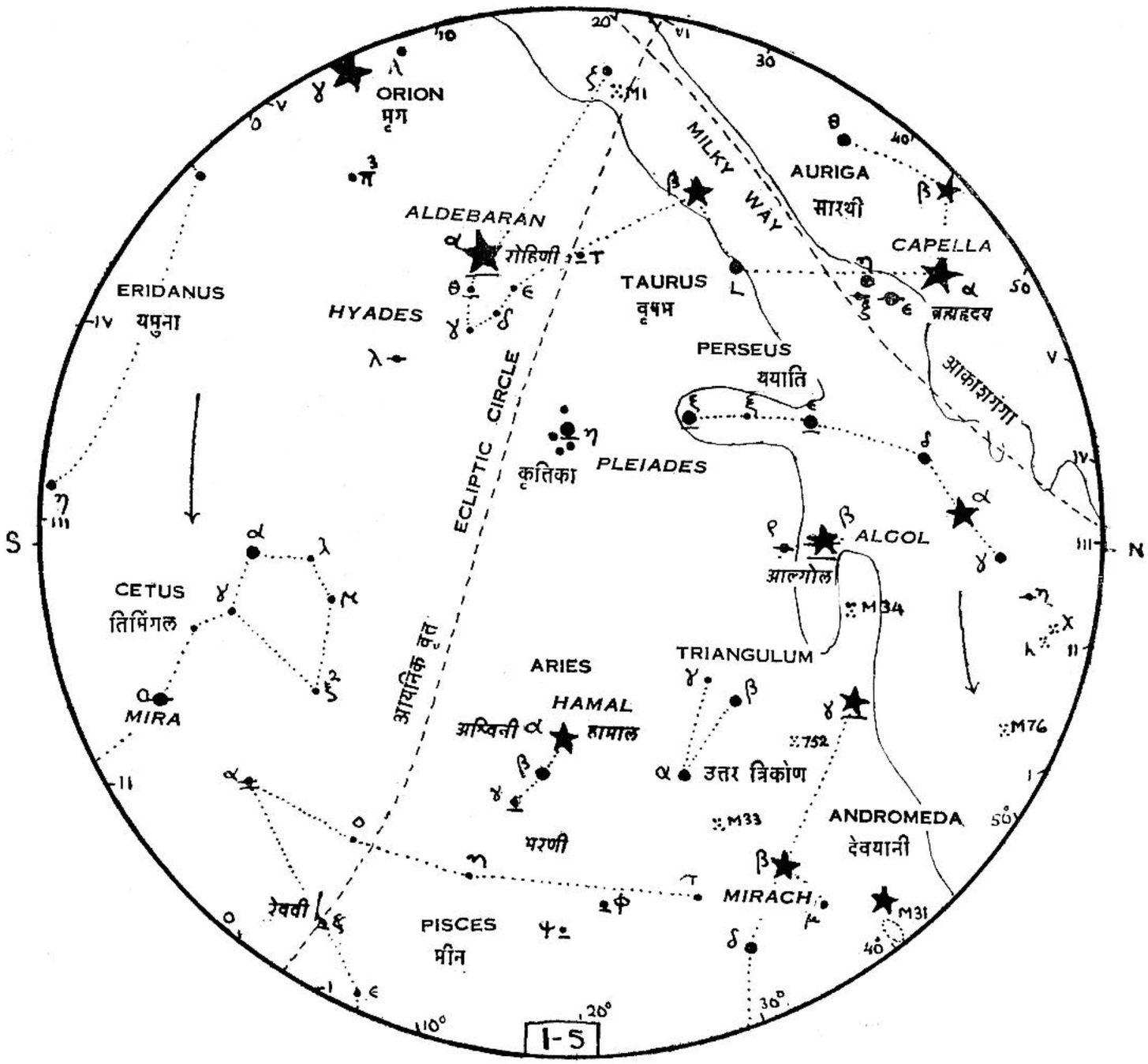
Being not far from Hyades (*ROHIṆI*) and the star Aldebaran being easily recognizable in the night sky, Pleiades (*KṚTTIKĀ*), have attained a special significance.

At the present time during the Indian month of *KĀRTIKA* (which corresponds to October or November generally) it is known that the constellation *KṚTTIKĀ* is above the horizon in the evening and vanishes below the horizon in the very early morning. This fact is used by the religiously minded Hindus as a reliable time-keeper for their *KĀRTIKA-SNĀNA* ritual.

The brightest star of Pleiades is η in Taurus and it is called Alcyone. By itself it is a bright and wide double.

There is a faint nebula called Merope in the Pleiades near star 23.

* * *



Observers Latitude : 25° N

September	1	at	5	a.m. (I.S.T.)	September	15	at	4	a.m. (I.S.T.)
October	1	at	3	a. m.	October	15	at	2	a. m.
December	1	at	11	p. m.	December	15	at	10	p. m.
January	**1**	**at**	**9**	**p. m.**	**January**	**15**	**at**	**8**	**p. m.**
February	1	at	7	p. m.	February	15	at	6	p. m.

JANUARY ZENITH KEY-MAP

Milky Way

LOOKING AT the sky we see many stars. Some of them are bright and some are faint. The sight is very pleasant, but apart from the stars there is another magnificent phenomenon which we call the Milky Way. It is an irregular broad white band, which is luminous and which spreads through wide regions of the night sky depending upon the time of the year. The band runs through the constellations we know as Cygnus, Cepheus, Cassiopeia, Andromeda, Perseus, Auriga, Gemini and so on in the Northern Hemisphere. The band is also observed going through some constellations in the Southern Hemisphere, passing near Orion, Argo Navis (Carina, Puppis, Pyxis, Vela), Scorpius, Sagittarius, and getting back to the Northern Hemisphere, in Aquila.

Looking through a telescope the Milky Way begins to show several more stars crowded up. Astronomers consider that along this track there are countless stars and the accumulated light of these stars gives the band its silvery luminous glow. The band that we see, at any particular time, is only a portion of the system of stars, gas and dust of which our Sun forms part. Such an orderly system of stars is called a galaxy. That particular galaxy, in which our Sun is just one constitutent, is called the Milky Way or "Our Galaxy."

Apart from the stars, there are other interesting objects in the sky. They are collectively called Nebulae. To the naked eye or with an ordinary telescope, these objects appear as hazy diffuse spots. Sometimes they appear as clouds but they are invariably distinguishable from stars. Photographs of these hazy objects, we call nebulae, reveal their shapes. (See Page 151). A nebula which is external to our own galaxy, the Milky Way, is called an extra-galactic nebula. One such extra-galactic system, in the northern hemisphere and which we can observe even with the naked eye, is the Andromeda nebula M 31. In the Southern hemisphere Magellanic Clouds have become famous. (See Page 113)

From photographs taken with the help of large telescopes, it is now possible to form some idea of the shape and structure of our galaxy. Numerous stars are distributed throughout the shape.

The Milky Way has the shape of a flat round disc. The plane of the disc passes through the central region. The disc revolves around the centre but not necessarily as a solid body. The innermost part and the outermost both rotate more slowly than the part between. The general picture is that of a rotating potter's wheel with a bit of mud, representing the Sun, on one of its spokes placed at about a third of its length from the edge.

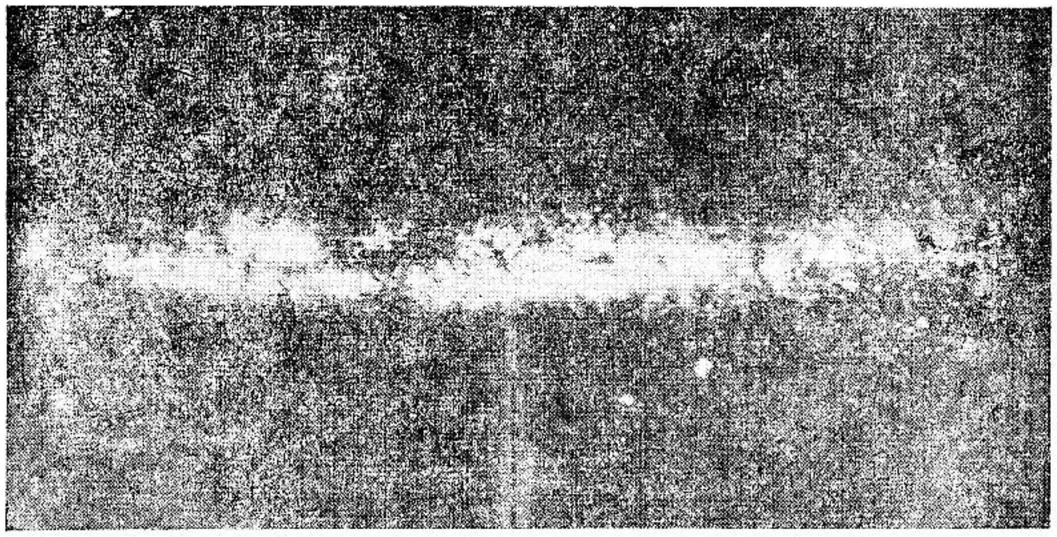


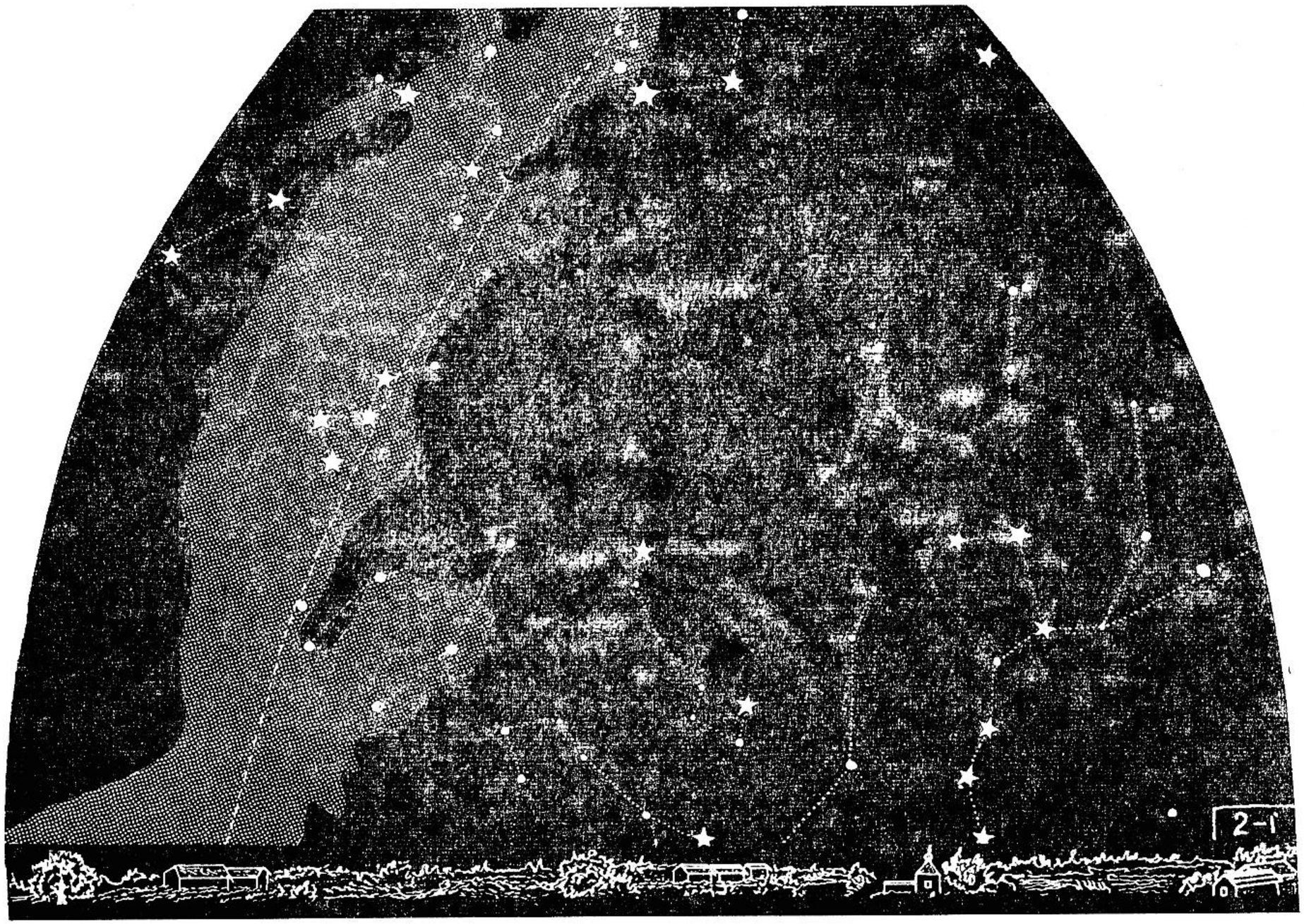
Fig. 1.10 Milky Way. This figure is prepared by Swedish artist astronomers.

The dimensions of the Milky Way are :

Diameter of the Milky Way Galaxy = 100,000 light years.
Thickness of the disc in the vicinity of the Sun = 2,500 light-years.
Sun's distance from the galactic centre = 30,000 light-years.

There are about 40×10^9 stars in the Milky Way and its total mass is estimated to be 2×10^{11} solar masses. The galactic disc has some spiral arms. One such arm contains the constellation Orion and the Sun.

(Continued on Page 35 Column 2)



Observer's Latitude 25° N

FEBRUARY NORTH NIGHT-SKY

October	1 at 5 p.m.(I.S.T.)	October 15 at 4 a.m. (I.S.T.)
November	1 at 3 a.m.	November 15 at 2 a.m.
January	1 at 11 p.m.	January 15 at 10 p.m.
February	**1 at 9 p.m.**	**February 15 at 8 p.m.**
March	1 at 7 p.m.	March 15 at 6 p.m.

Meteoric Showers

METEORS ARE small objects, metallic or stony in composition. Groups of these objects are revolving round the Sun. Sometimes their orbits and the Earth's orbit either cut each other or approach each other close enough, when these tiny objects enter the Earth's atmosphere and become hot and incandescent. When this happens, they are called " Shooting Stars"; but they are merely Meteors falling towards the Earth.

The number of visible Meteors, penetrating the Earth's atmosphere in a day is estimated at about 25 million. Whenever the Earth's orbit intersects the orbit of a stream of Meteors, we see what is known as a Meteoric Shower. Earth meets these meteoric streams very regularly in its orbit round the Sun and whenever that happens we see an unusually large number of Shooting Stars or Meteoric Showers coming from some definite part of the sky. This part is known as the Radiant. The Showers occur very regularly at a fixed time and with a fixed Radiant. They are, therefore, named after the constellation in which the Radiant happens to be situated.

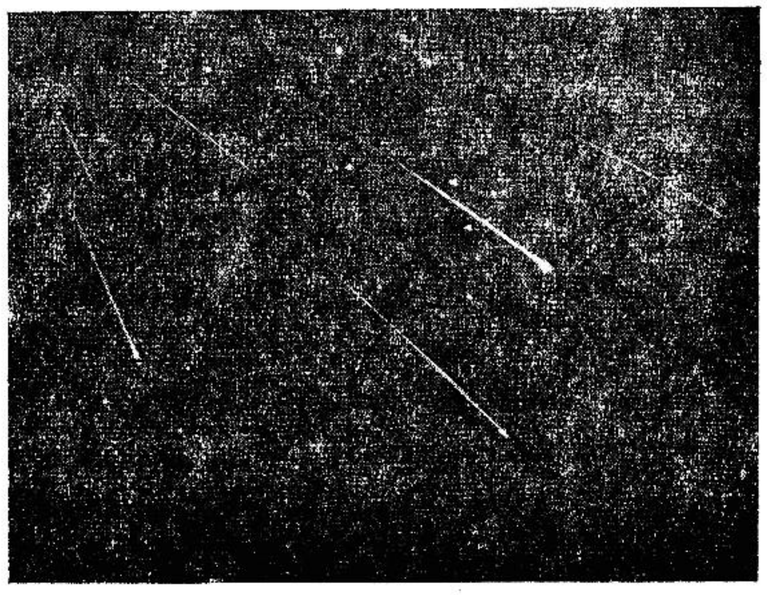


Fig. 2.1 : Meteoric Showers.

The showers coming from Lyra are called the *Lyrids* and they occur from 20th to 22nd April, having a maximum on 21st.

The *Arietids* come from Aries during the period from 30th May to 14th June and are maximum on 7th June.

A stream with its radiant at 5° to the east of Altair, in Aquila, is seen from 7th June to 12th August.

Showers coming from Perseus are called the *Perseids*. They occur from the 1st to 20th. August and are maximum on 12th.

The *Leonids* come from Leo. Their period is from 11th to 20th November, with a maximum on 12th.

The *Andromedids* from Andromeda occur from the 18th to 26th November.

The *Geminids* occur from Gemini during the period from 9th to 14th December having a maximum on 12th.

* * *

MILKY WAY

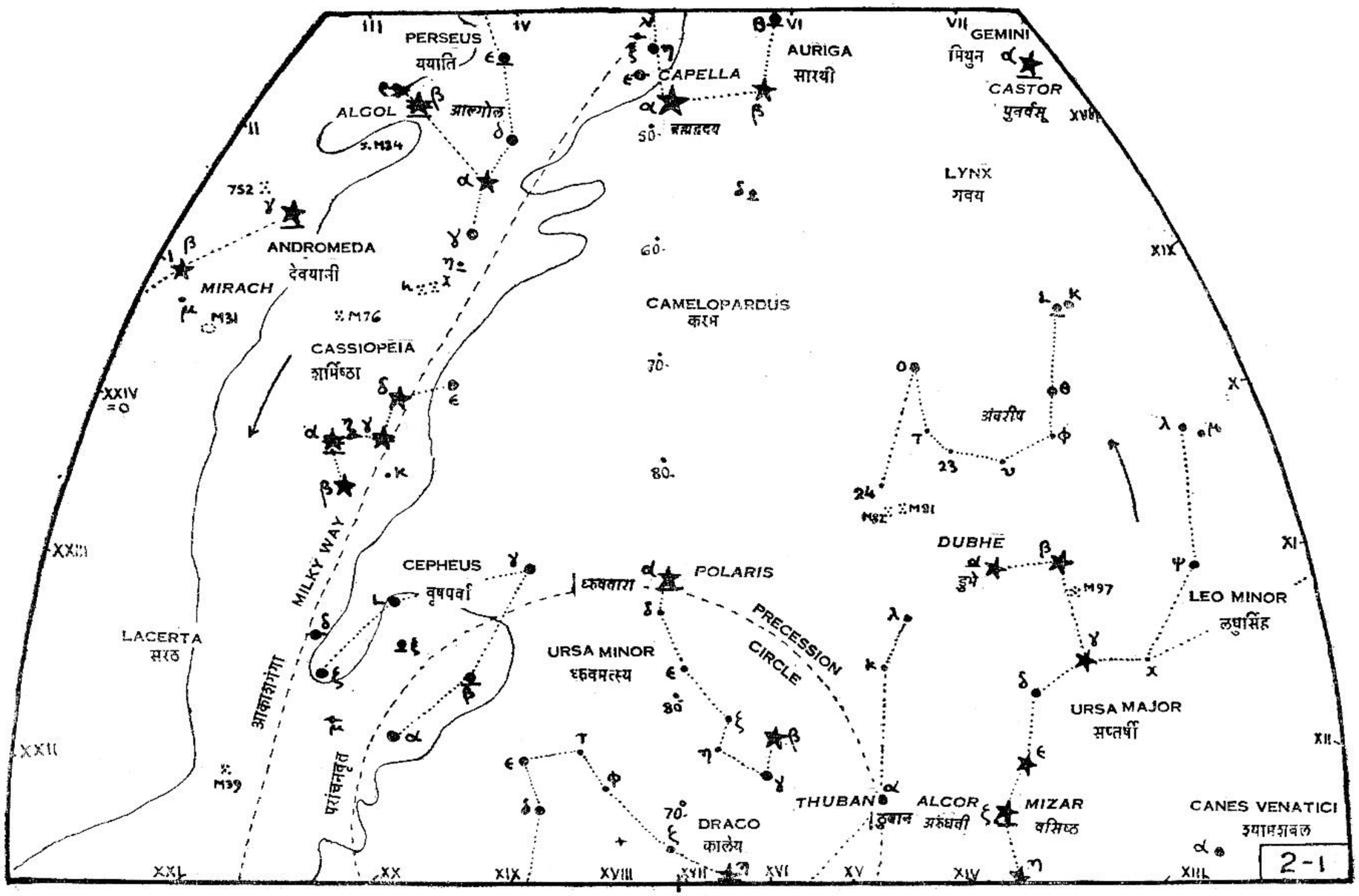
(Continued from Page 33 Column 2

The Sun makes one revolution inside the galaxy in 200 million years. It is in this movement that our entire Solar system is being carried through space towards the constellation Hercules with a speed of 20 Km per second.

The number of galaxies is very large. We can see only some of them. 48 inch (110 cm.) Schmidt telescope has revealed about 2500 galaxies per square degree and an average of 150 star clusters per 100 square degrees.

Andromeda Nebula is an external galaxy of a spiral structure. The system is similar in form to our galaxy but considerably larger. Its distance is about 2.2 million light-years and its diameter about 200,000 light-years. Its mass is 3.3×10^{11} that of the Sun.

* * *



Observer's Latitude : 25° N

FEBRUARY
NORTH
KEY-MAP

October	1 at 5 p.m. (I.S.T.)	October	15 at 4 a.m. (I.S.T.)
November	1 at 3 a.m.	November	15 at 2 a.m.
January	1 at 11 p.m.	January	15 at 10 p.m.
February	**1 at 9 p.m.**	**February**	**15 at 8 p.m.**
March	1 at 7 p.m.	March	15 at 6 p.m.

FEBRUARY : NORTH KEY

Prominent Stars :

β, γ in Andromeda (Mirach and Almakh)
α in Auriga (Capella)
β in Cassiopeia (Caph) near hour-angle XXIV.
α in Draco (Thuban). Former Pole Star, about 3000 B.C.
β in Perseus (Algol)
α in Gemini (Castor)
α, β in Ursa Major (the Pointers)
ζ in Ursa Major (Mizar) and its companion (Alcor)
α in Ursa Minor (Polaris), the present Pole Star.

Double Stars :

γ in Andromeda, gold and blue, magnificient object for a small telescope.

η in Cassiopeia, seen with a 5 cm. telescope, period of 526 years.

β, ξ in Cepheus seen with a 5 cm. telescope.

ε in Gemini is sextuple, a very fine object. Its 2 main components, seen with a 5 cm. telescope, have a period of 380 years. Each of the components is a binary and there is another star which is an eclipsing binary.

β in Perseus (Algol), eclipsing binary, known since 300 years ago, components are dark and bright. With its 2 more components it becomes a quadruplet.

ε, ζ, η, in Perseus, seen with a 5 cm. telescope. Components of η are yellow and blue.

α in Ursa Major, seen with a 5 cm. telescope.

ζ in Ursa Major has a companion Alcor, seen with naked eyes. ζ (Mizar) itself is a double, seen with a 5 cm. telescope.

Variable Stars :

ε, ζ in Auriga are eclipsing variables with periods of 9883 and 972 days respectively.

δ in Cepheus, a short period variable and is Cepheid-prototype.

β in Perseus (Algol) is regularly variable and a type. Its period is 2 days 20 hours 48.9 minutes.

Nebulae and Star Clusters

M 76 near φ in Perseus, resembles a dumb-bell.
This nebula belongs to our galaxy.
M 31 (NGC 224) in Andromeda, near ν, visible to naked eyes.
NGC 752 in Andromeda near γ, large and open, seen with field-glasses.

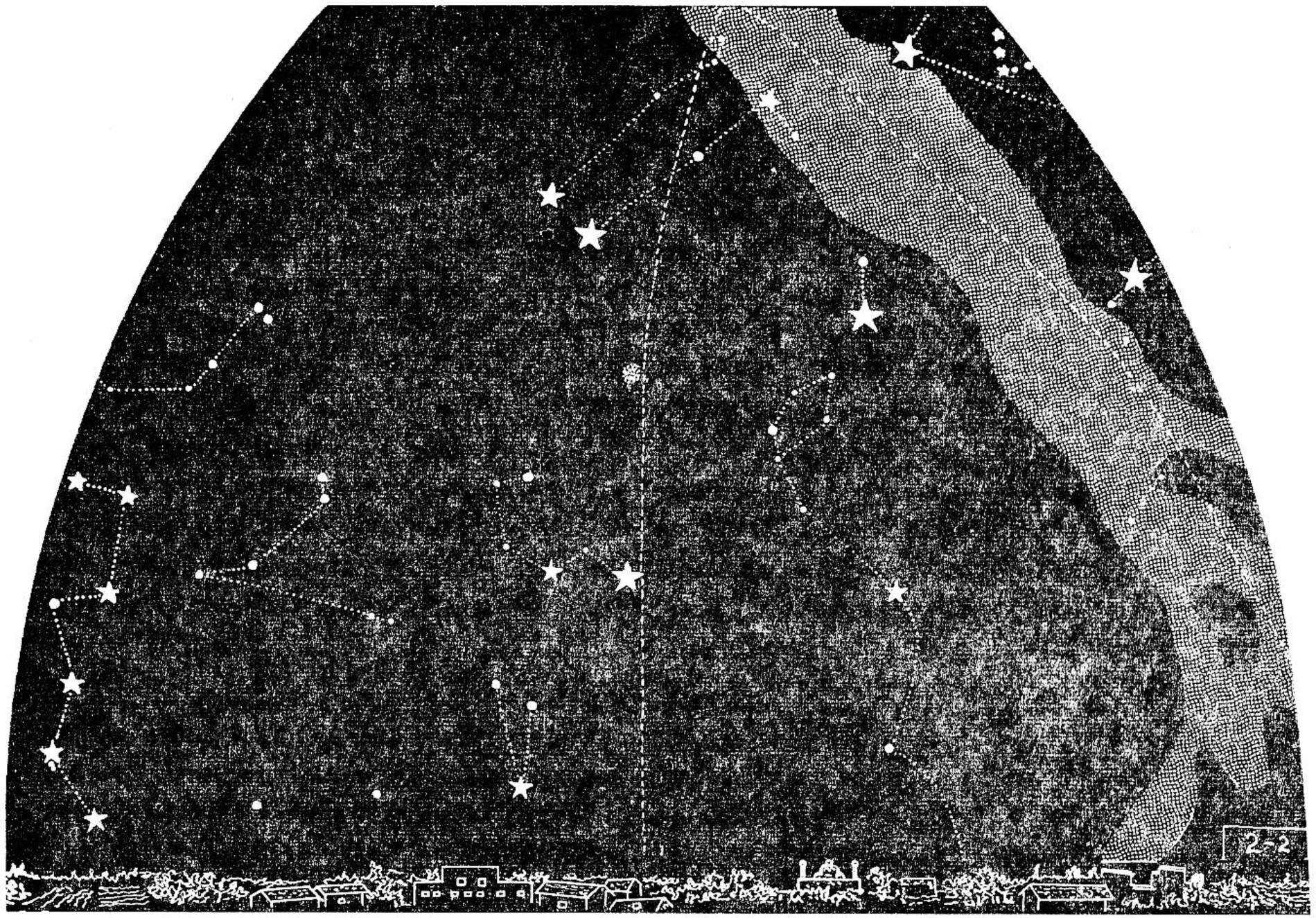
M 35 (NGC 2168) above μ and η of Gemini, seen with naked eyes.

h (NGC 869) and χ (NGC 884) in Perseus, seen with naked eyes as bright and beautiful diffuse spots.

M 81 (NGC 3031) and M 82 (NGC 3034) in Ursa Major. Both can be seen together with very low power field-glass.

M 97 (NGC 3587) in Ursa Major between β and γ.

* * *



Observer's Latitude 25 N

FEBRUARY
EAST
NIGHT-SKY

October	1	at	5 p.m.	(I.S.T.)
November	1	at	3 a.m.	
January	1	at	11 p.m.	
February	**1**	**at**	**9 p.m.**	
March	1	at	7 p.m.	

October	15	at	4 a.m.	(I.S.T.)
November	15	at	2 a.m.	
January	15	at	10 p.m.	
February	**15**	**at**	**8 p.m.**	
March	15	at	6 p.m.	

Gemini (*MITHUNA*)

THIS CONSTELLATION, popularly known as Twins in western astronomy, or as *MITHUNA* (मिथुन) in Indian astronomy, lies near the stream of the Milky Way, just above the bright star Procyon of Canis Minor and below the bright star Capella of Auriga and in front of the bright star Regulus of Leo, the Lion. The pictorial representation of the Twins is such as to place their feet among the stars near the edge of the Milky Way. The heads of the Twins extend towards the north-east, in the same general direction as the horns of Taurus, the Bull. These horns appear to be thrust into the stream on the other side of the Milky Way.

The prominent stars are Castor and Pollux, and in the picture they are on the brows of the Twins. Pollux appears orange and Castor greenish white in colour.

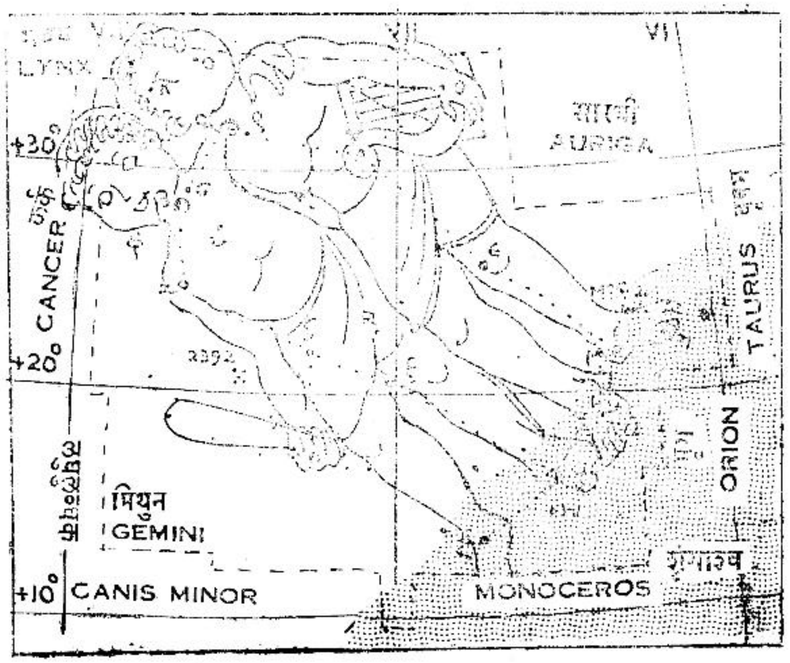


Fig 2.2 Gemini (Mithuna)

Castor and Pollux were two young lambs according to Egyptian mythology; but according to Greek mythology they were the sons of Leda and brothers of Helen of Troy. These Twins were known for their bravery and very much respected both in Sparta and in Rome. One of the best known exploits of these brave Twins was the journey after the Golden Fleece on the ship Argo. This boat was very fragile and when it got caught in a storm it was severely tossed about. Orphens attempted to calm the waters and when he succeeded in doing so two stars suddenly appeared above the heads of the twins. (Modern version of this legend suggests that this can be static electricity, which sometimes appears like two stars of light, attaching itself to each mast of the ship). But the ancient Greeks regarded the appearance of two stars as an auspicious sign from Jupitor, indicating that all was well and there was nothing to fear from the storm any more. Castor and Pollux are the names henceforth given to the two lights at the mast-heads. When these stars appear in the sky, sailors predict fair weather.

According to Indian astronomical reckoning, Gemini includes the constellations *ĀRDRĀ* (आर्द्रा) and *PUNARVASŪ*. (पुनर्वसू). *ĀRDRA*, in Sanskṛta, means wet and when the sun reaches this constellation it should be proper rainy season. It is not so now, but the reason for the shift is 'precession of the equinoxes.' The rainy season at present begins with the constellation *MṚGA* (मृग) (Orion), although it is known that in the period about 600 B. C. the rainy season did coincide with the approach of the sun in *ĀRDRĀ*. The star γ (Alhena) corresponds to *ĀRDRĀ* (आर्द्रा) in Indian Astronomy.

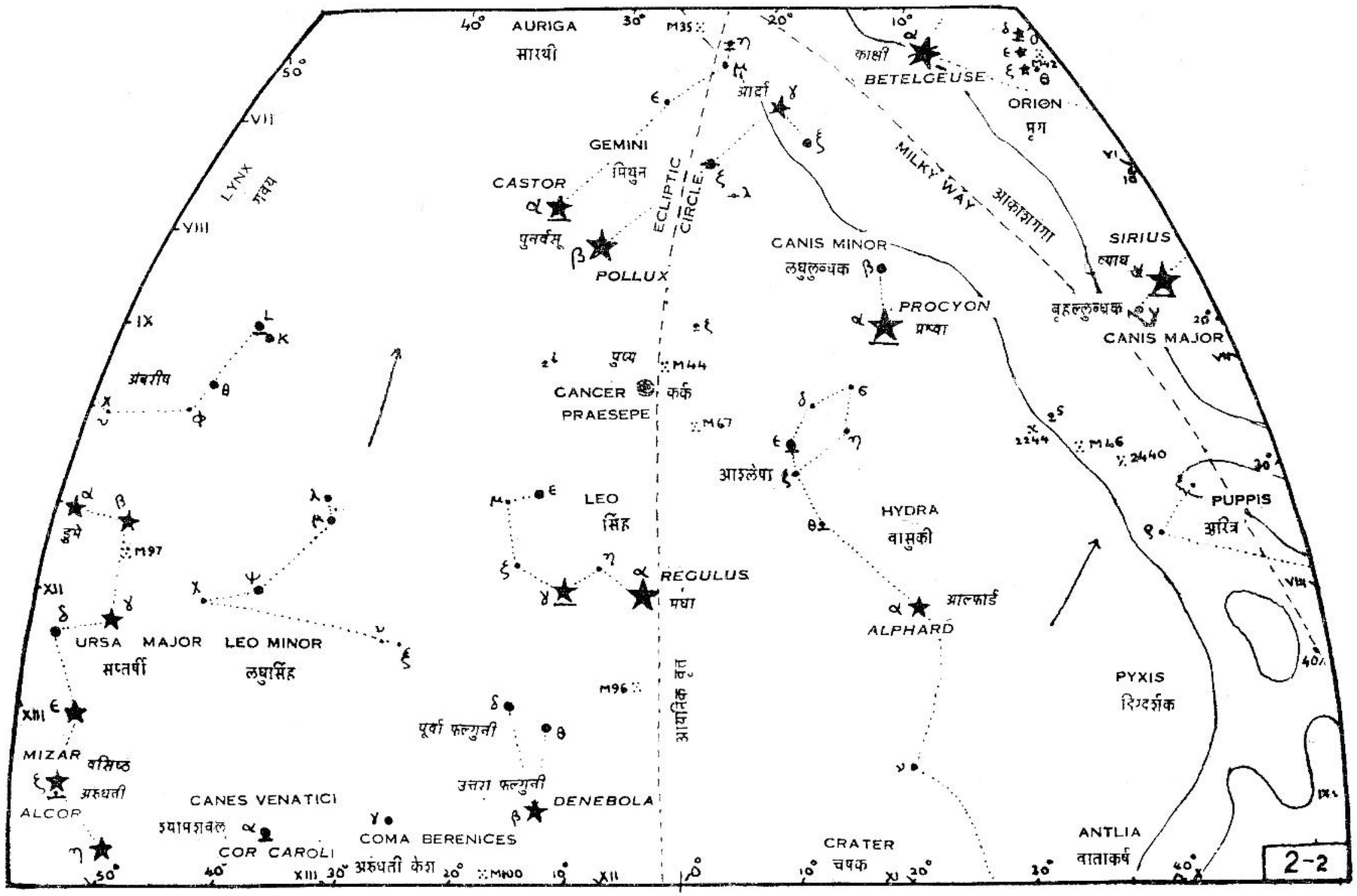
Castor is a very fine double and a binary star, in slow retrograde motion, with a period of about 350 years. The component stars were at their widest distance about 1880. A. D. They are now closing up gradually and will continue to do so for some years. Both stars are spectroscopic binaries, with periods of only 3 and 9 days respectively. A third faint star, also a binary, forms part of the same system.

Both Castor and Pollux are our near neighbours :

Distance of Castor from us = 14 parsecs = 45 light-years.

Distance of Pollux from us = 10 parsecs = 33 light-years.

(Continued on Page 41 Column 2)



Observer's Latitude 25° N

FEBRUARY
EAST
KEY-MAP

October	1	at 5 p.m. (I. S. T.)	October	15	at 4 a.m. (I. S. T.)
November	1	at 3 a.m.	November	15	at 2 a.m.
January	1	at 11 p.m.	January	15	at 10 p.m.
February	**1**	**at 9 p.m.**	**February**	**15**	**at 8 p.m.**
March	1	at 7 p.m.	March	15	at 6 p.m.

FEBRUARY : EAST KEY

Prominent Stars

α in Canis Minor (Procyon)
α in Canis Major (Sirius), brightest star in he sky
α and β in Gemini (Castor and Pollux)
α in Hydra (Alphard)
α in Leo (Regulus), on the Ecliptic.
β in Leo (Denebola)
α, β in Ursa Major (The Pointers)
ξ in Ursa Major (Mizar) and its companion (Alcor)

Double Stars

ι in Cancer, seen with field glasses.
ξ in Cancer, it is a famous triplet
α in Canis Major (Sirius) with a Dwarf companion.
α in Gemini (Castor) is a sextuple seen with 5 cm. telescope
θ in Hydra, can be seen with a 7.5 cm. telescope.
γ in Leo, seen with a 7.5 cm telescope

Variable Stars

ζ in Gemini, seen with a 5 cm. telescope
R in Hydra, belongs to the Mira type, has a period of 442 days.

Nebulae and Star Clusters

M 44 (NGC 2634) or " Praesepe " (Honey-comb), near δ in Cancer, seen with naked eyes.

M 67 (NGC 2682) near α in Cancer, seen with field glasses.

M 35 (NGC 2168) above μ and η of Gemini, seen with naked eyes.

M 96 (NGC 3368) between α and β of Leo. It is a spiral nebula seen with field glasses.

M 46 (NGC 2437) and (NGC 2440) in Puppis, both can be seen together with field glasses.

* * *

GEMINI

(Continued from Page 39 Column 2)

There is a star cluster in Gemini above the stars μ and η and it lies between ε of Gemini and ζ of Taurus. The cluster is called M 35 (NGC 2168) and can be located easily with a field glass.

* * *

The Current Round of the Earth through the Milky Way

The galaxy which contains our Sun is called the Milky Way. Our Earth, completes one revolution in this galaxy about its centre in approximately 220 million years. The picture below shows the different geological periods and corresponding known fossils during the current revolution of the Sun in its galatic orbit.

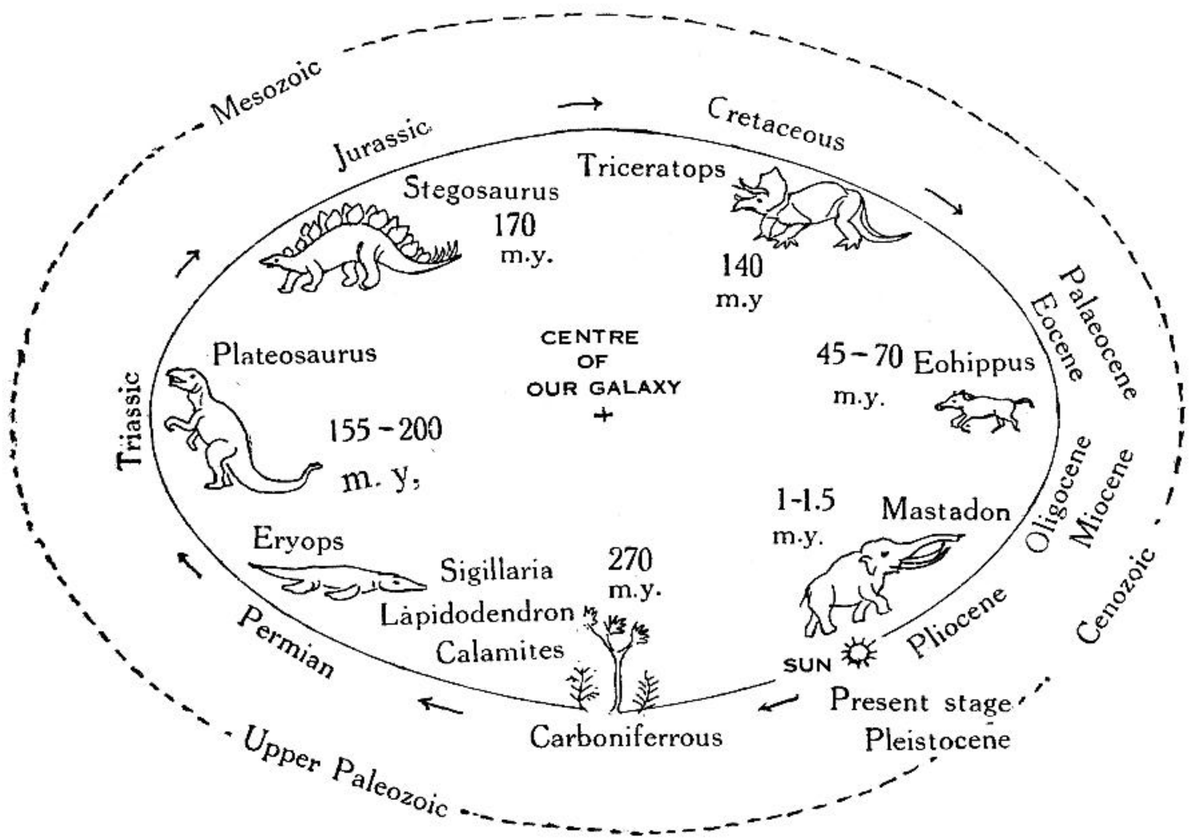
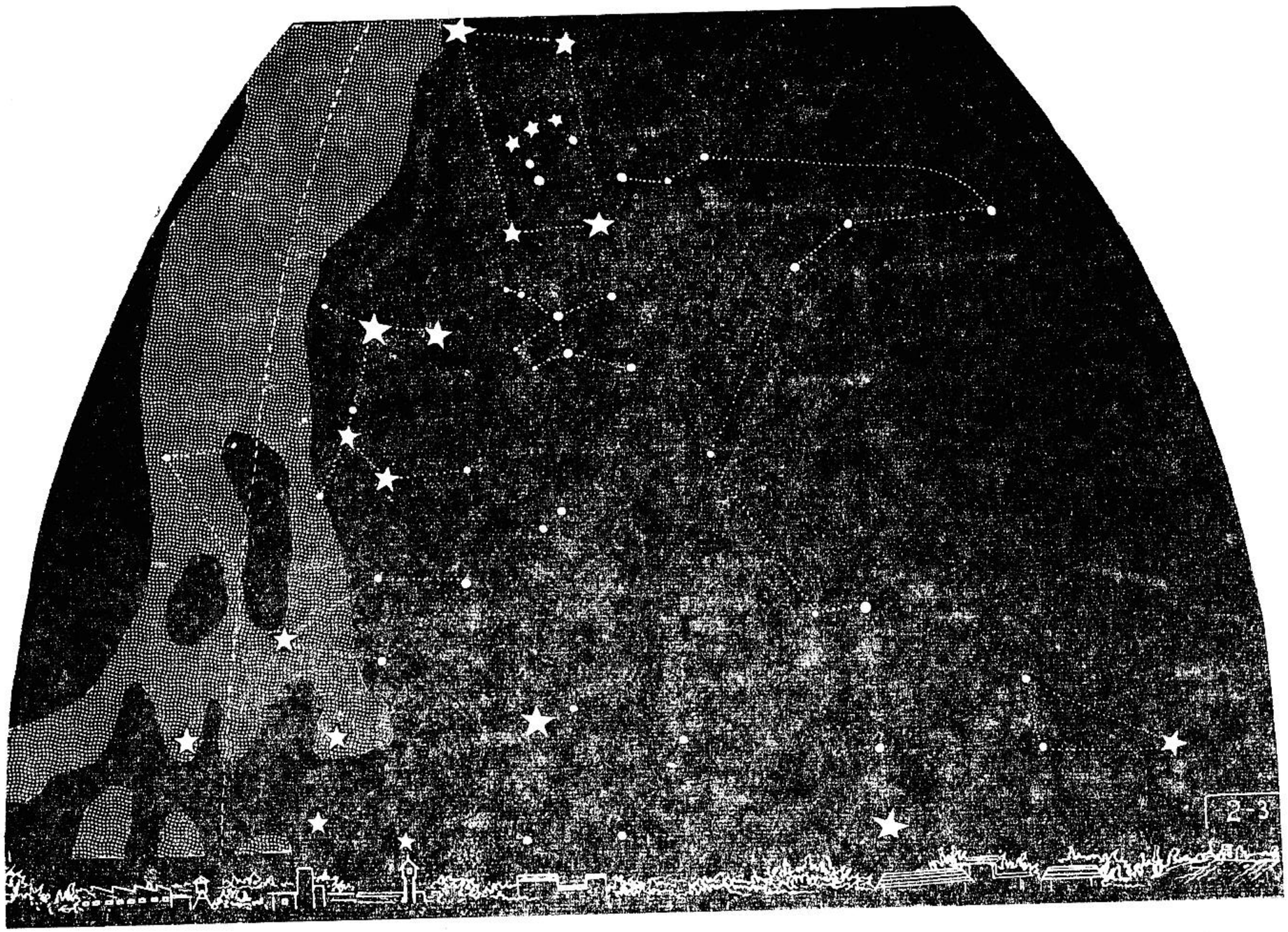


Fig. 2.3 Geological periods on the Earth

* * *



Observer's Latitude : 25° N

FEBRUARY
SOUTH
NIGHT-SKY

October	1 at	5 p. m. (I. S. T.)
November	1 at	3 a. m.
January	1 at	11 p. m.
February	**1 at**	**9 p. m.**
March	1 at	7 p. m.

October	15 at	4 a. m. (I. S. T.)
November	15 at	2 a. m.
January	15 at	10 p. m.
February	**15 at**	**8 p. m.**
March	15 at	6 p. m.

Eridanus

THIS CONSTELLATION, meaning the Celestial River, starts at the foot of Orion, near Rigel and extends in a great arc downwards to the southern horizon. This is a very long constellation, winding its way between Orion and Cetus. It reaches as far south as declination circle 70° and its eastward spread lies between hour-angles I and V.

According to Greek Mythology, Phaethon was the son of Apollo, the Sun God, who rides all the time with pomp and splendour through the skies. Phaethon, desirous of doing the same, approached his father and bagged to be allowed the privilege of driving the Sun's chariot. Apollo did not cherish the idea, but, out of affection for his son, yielded very unwillingly. The youngster Phaethon felt happy, jumped into the chariot and drove the celestial horses like mad along the Zodiac. The constellations * that lay on this path did not like the mad son and his snow-white horses tearing up through the sky. They protested and jointly created so much fear in the youngster's mind that he finally lost control. Jupiter threw his thunderbolt and the driver, the horses and the chariot crashed into a neighbouring river. This was the river Eridanus. As a result of the crash the river was burnt up. Some consider the river to be the Nile, while others consider that the name Eridanus came from the name of a village Eridu, which was situated on the confluence of two rivers in the days of the Chaldeans.

After the mad celestial drive, everybody felt sorry for the incident. Apollo represented that he should not have allowed the youth to drive the chariot. Jupiter regretted that he threw his thunderbolt at the wild flight of the horses carrying the Sun. Jupiter, later, raised the river Eridanus to the skies as a constellation and Apollo thus continues to have a pleasant view of the river in his daily rounds.

This constellation can be only partly seen by observers in the northern hemisphere and as such in the days of Ptolemy it was believed to terminate at the star θ (Ekamer) of magnitude 3. Accordingly, being regarded as 'the end of the river' it was named Achernar. When, however, the constellation came to be extended upto Latitude 70° South the name Achernar, meaning End of the River, was transferred to the end star α of the magnitude 0.6. The star θ formerly designated as Achernar is now Ekamer. The other star names along the river are β (Kursa), γ (Zarak) and 40 (Kaid). The Indian name for α (Achernar) is *Agranada*. (अग्रनद). It is suggested that both the

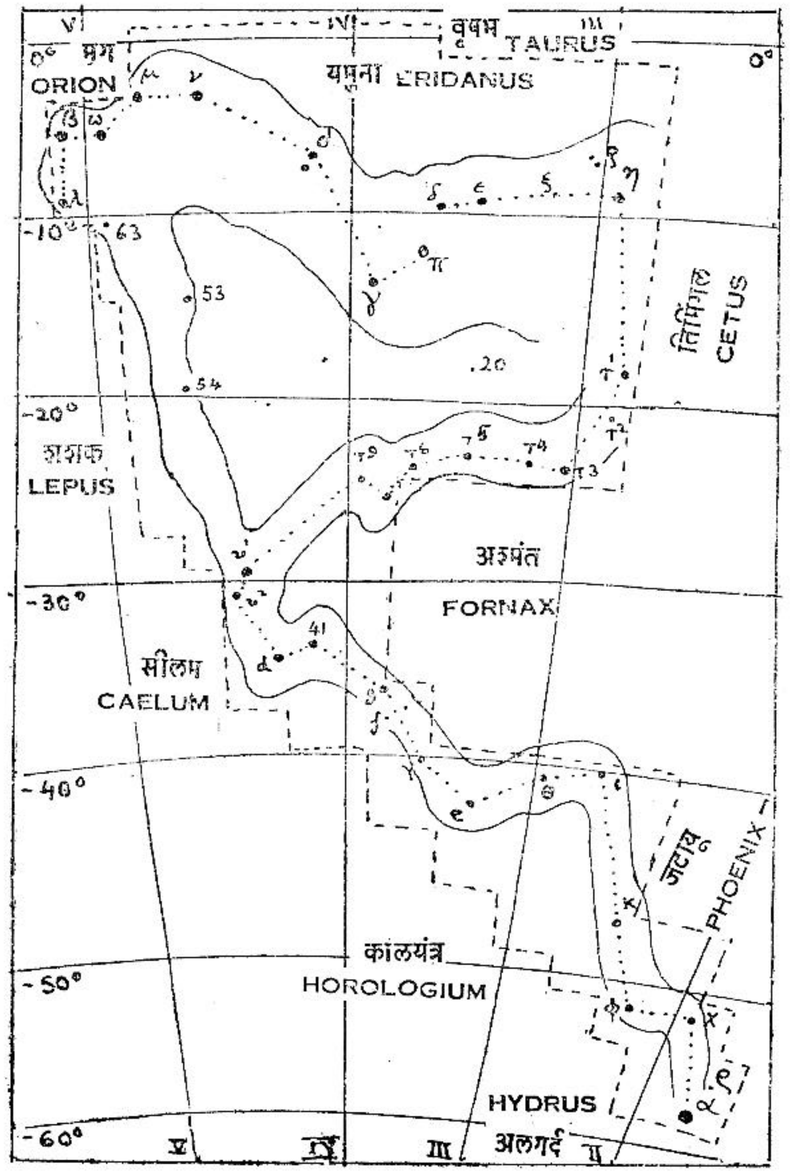
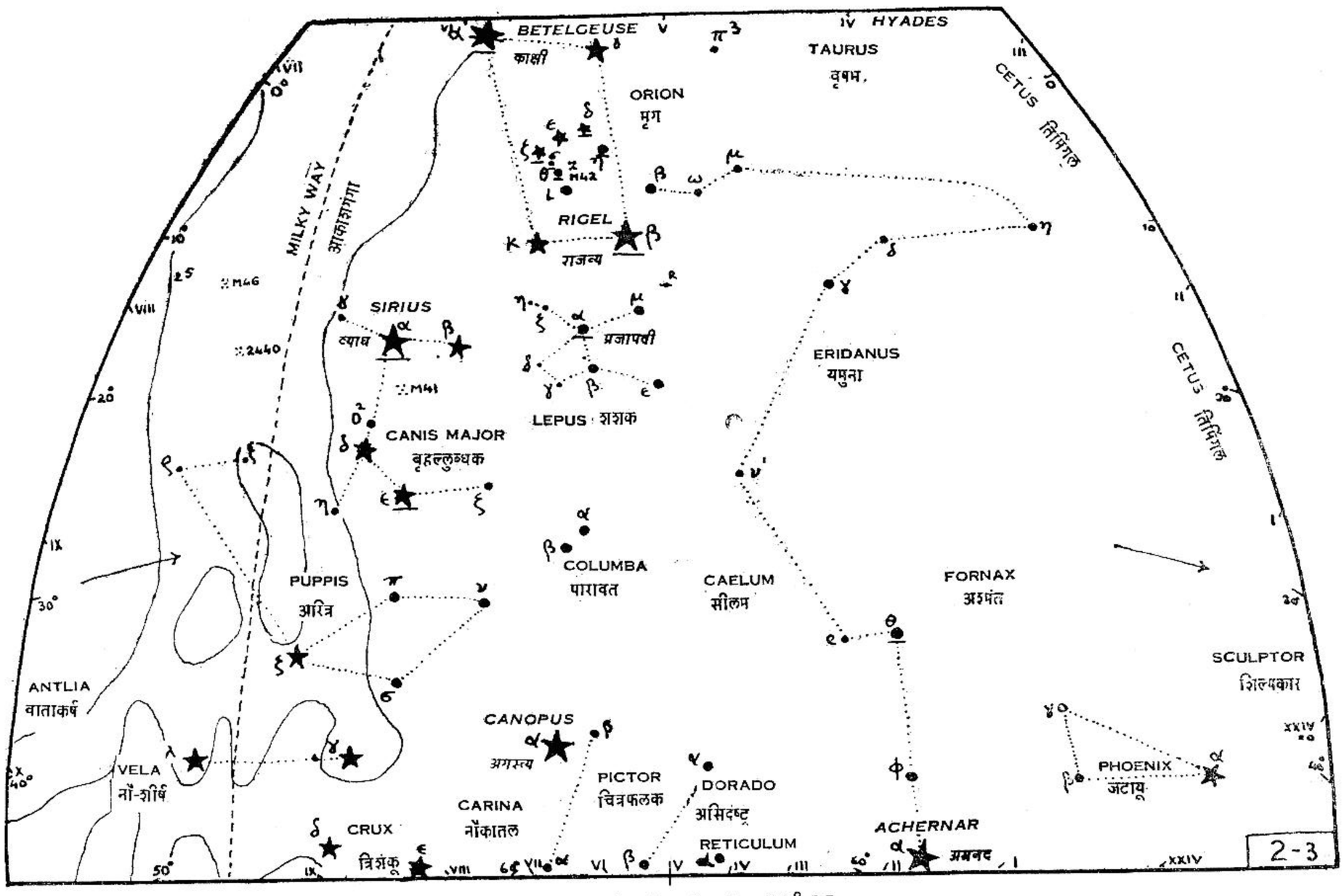


Fig. 2.4 Eridanus (YAMUNĀ)

(Continued on Page 45 Column 2)

* See Scorpius on page 143.



Observer's Latitude 25° N

FEBRUARY
SOUTH
KEY-MAP

October	1 at	5 p. m.	(I. S. T.)
November	1 at	3 p. m.	
January	1 at	11 p. m.	
February	**1 at**	**9 p. m.**	
March	1 at	7 p. m.	

October	15 at	4 a. m.	(I. S. T.)
November	15 at	2 a. m.	
January	15 at	10 p. m.	
February	**15 at**	**5 p. m.**	
March	15 at	6 p. m.	

FEBRUARY : SOUTH KEY 2 - 3

Prominent Stars :

α in Canis Major (Sirius)
α in Cairna (Canopus)
α and β Orion (Betelgeuse and Rigel)
α in Eridanus (Achernar)
α in Phoenix, in the South-West corner near the horizon,
γ and λ in Vela near the South-East horizon.

Double Stars :

α in Canis Major; seen only with a large telescope, because the companion is 10 magnitudes fainter. It is a white dwarf and of excessive density.
0 in Eridanus (This star Ekamer was formerly called Achernar)
δ in Orion, seen with a field glass or binoculars.
θ, in Orion, can be resolved into 4 by a 5 cm. telescope.
β in Orion, seen with 5 cm. telescope.
ζ in Orion, test for a 5 cm. telescope.

Variable Stars :

η in Carina was brighter than Rigel in 1938. It faded in 1843 and became bright again. It is of Nova type.
α in Orion, which is irregularly variable.

Nebula and Star Clusters :

M 41 (NGC 2287) in Canis Major, about 5° below Sirius, just visible with naked eyes.
M 42 (NGC 1976) in Orion below σ in the belt. This is called the Great Orion Nebula. Seen with naked eyes, looks like a faint cloud.
M 46 (NGC 2437) and NGC 2440 in Puppis, almost on the same Latitude as Sirius, both are beautiful clusters, seen with field glasses.

* * *

ERIDANUS

(Continued from Page 43 Column 2)

names, Achernar and Agranada, may have a common origin, since both have the same meaning " end of the river ". There are several bright stars in the constellation and the river appears to split itself into two streams. The 3 bright stars, in the southern hemisphere, Achernar, Canopus and Fomalhaut are regarded by the western philosophers and poets as symbols of Nobility, Trust and Hope respectively.

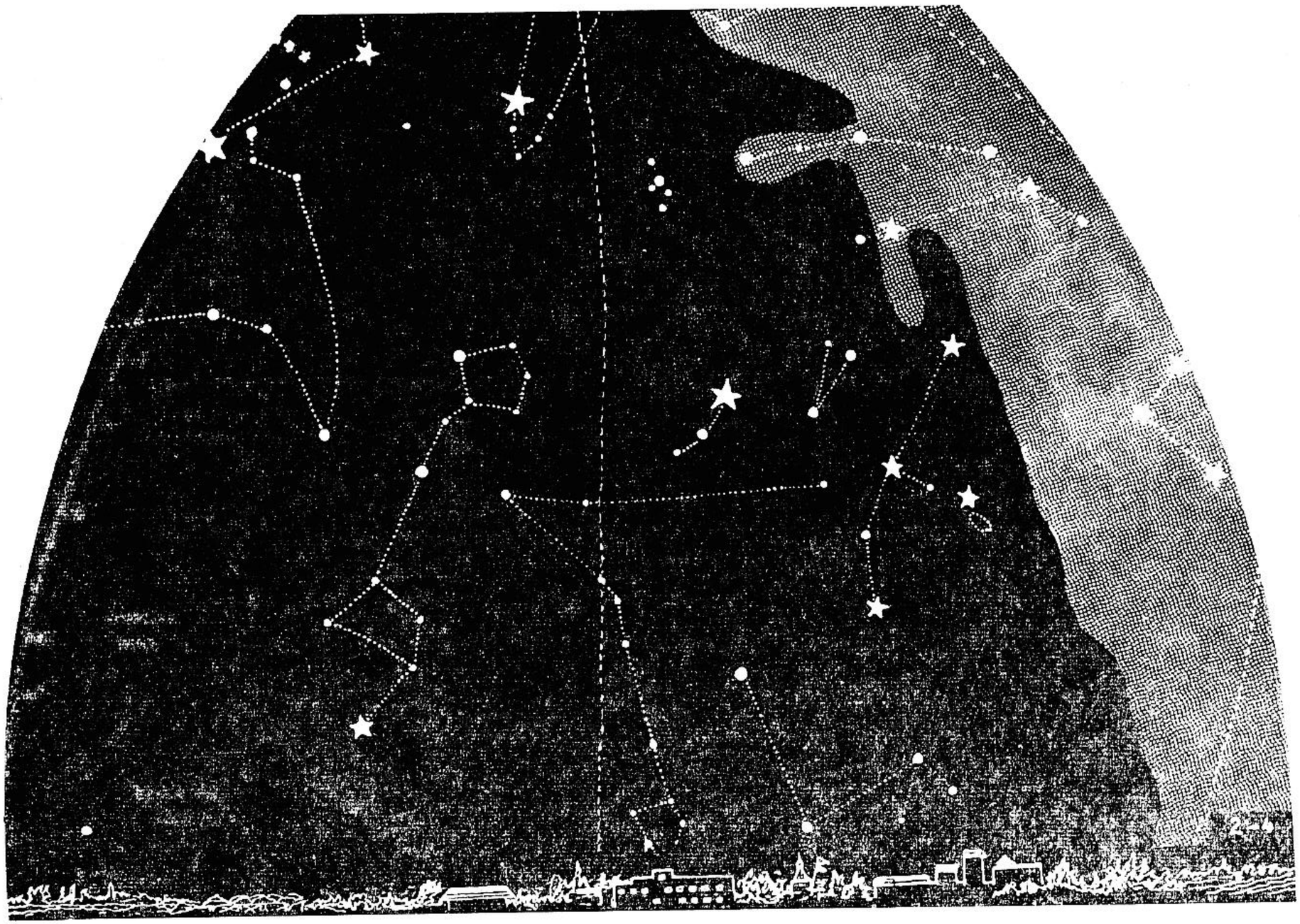
* * *

Some Giant Stars and Dwarf Stars*

Star	Diameter witn Sun=1 (observed)	(calculated)	Type
ζ Aurigae B	2000	...	Star Giants
α Orionis**	300 to 223	400	
α Scorpii	300	320	
β Pegasi	110	120	
α Tauri	36	57	Giants
α Boötes	23	26	
β Aurigae		16	
α Procyon A (in Canis Minor)		1.7	Main sequence Dwarfs
α Centauris E		1.2	
SUN	1.0	1.0	
ω Ursa Majoris A	0.9		
70 Ophiuchi B		0.7	
α Sirius B (in Canis Major)		0.02	White Dwarfs
40 Eridani B		0.02	
van Mannen 2		0.006	
Wolf 457		0.003	

* See page 53 for Dwarfs and Giants
** Diameter of this star changes

* * *



Observer's Latitude : 25 N°

October	1 at 5 p. m. (I. S. I.)	October 15 at 4 a. m. (I. S. T.)
November	1 at 3 a. m.	November 15 at 2 a. m.
January	1 at 11 p. m.	January 15 at 10 p. m.
February	**1 at 9 p. m.**	**February 15 at 8 p. m.**
March	1 at 7 p. m.	March 15 at 6 p. m.

FEBRUARY
WEST
NIGHT-SKY

Orion

MOST of us cannot fail to locate the constellation Orion, which is called *Mṛga Śīrṣa* (मृगशीर्ष) (Head of an antelope) in Indian astronomy. Some call it only Mṛga(मृग) which means Antelope.

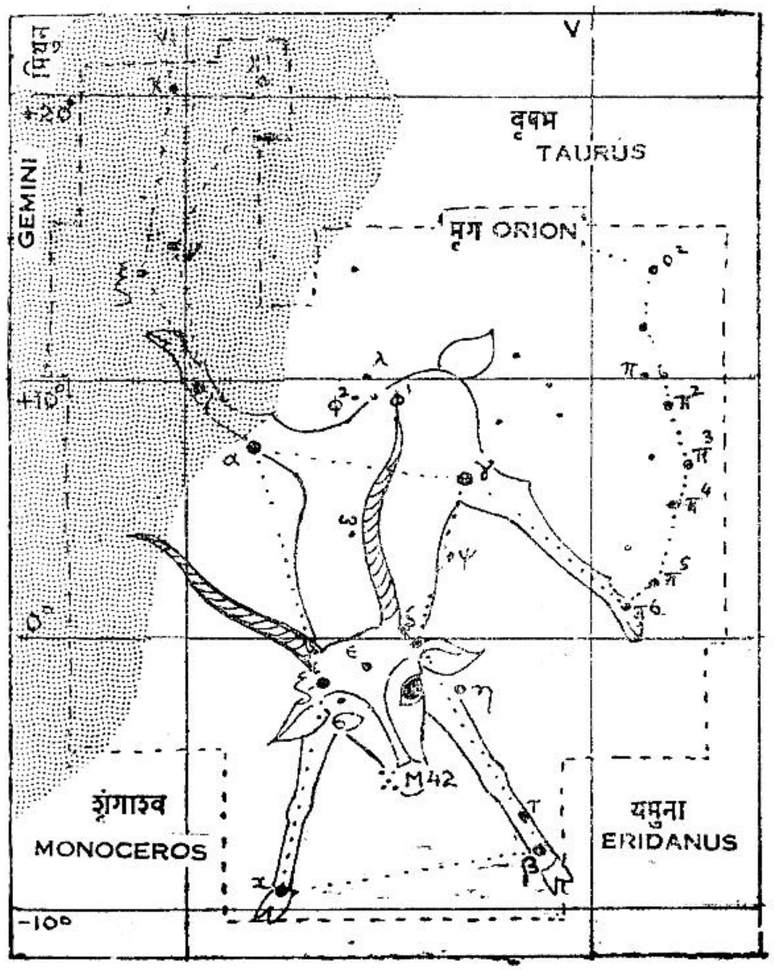


Fig. 2.5 Orion (Head of an antelope) (Mṛga śīrṣa)

During its annual journey in the sky, through the Ecliptic, when the Sun enters this constellation it is the beginning of the monsoon season and the time is about the middle of June. In the month of February, Orion rises early in the evening.

There are in all about 13 stars which are visible, but of them four are very bright and, when joined up, they form a four-sided figure. Near the centre of this figure there are 3 bright stars, in a straight line, making some angle with the diagonal of the four sided figure.

According to the Indian version the 4 stars, α, β, γ and κ represent the four legs of the antelope and the 3 stars, in a line, ζ, ε, δ represent the arrow which hit the antelope when it was thrown at it by the hunter Sirius. It can be noted that Sirius is almost in line with the continuation of the 3 centrally situated stars.

Looking westward, we find Orion. On our left and slightly to the right is Aldebaran. (α in Taurus-Hyades) and to the north-west we find Castor and Pollux (α and β of Gemini).

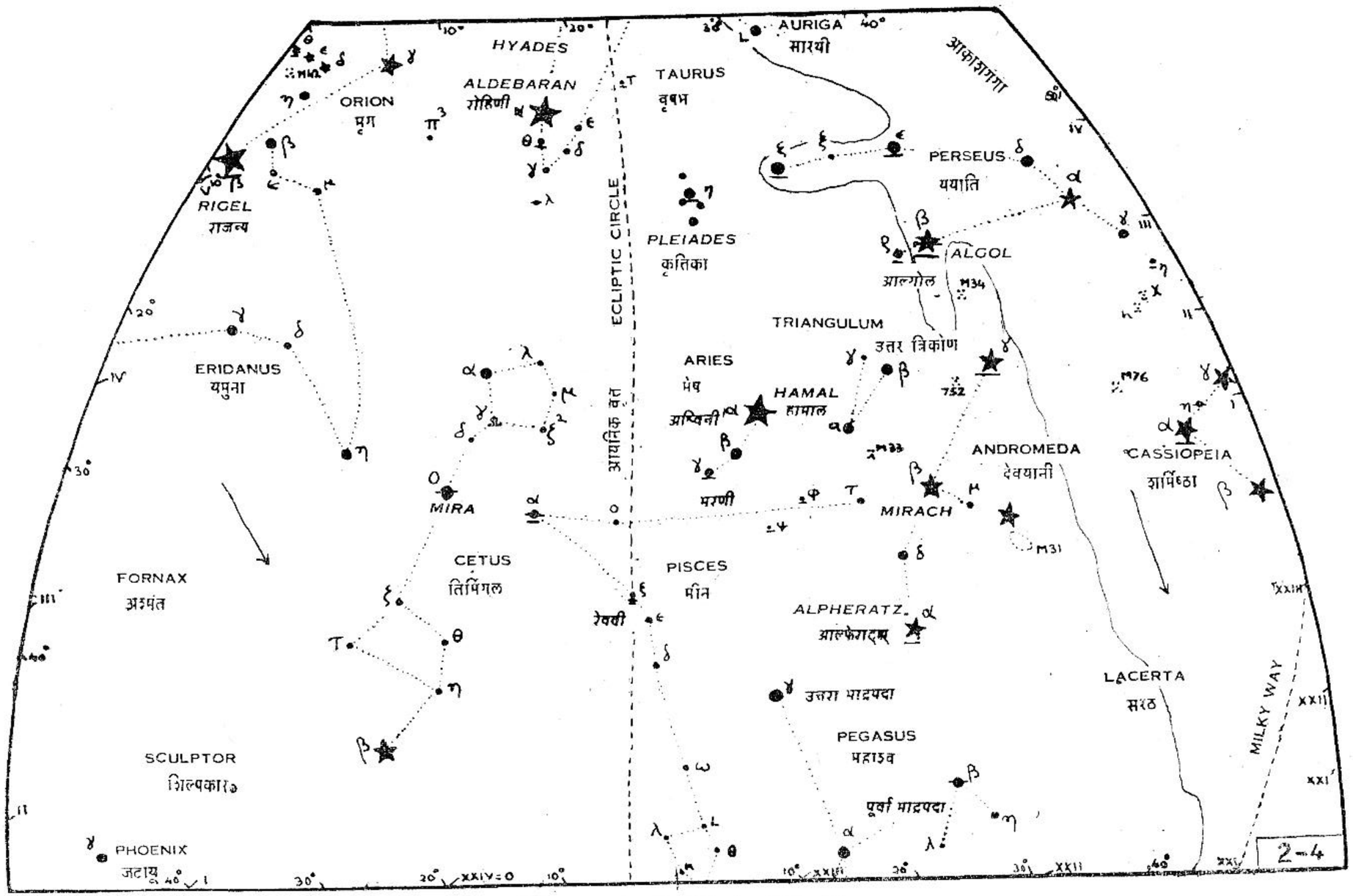
The brightest red-tinted star α is called Betelgeuse and is of magnitude 1; but its brightness is irregularly variable. Its diameter is about 400 times and its mass about 10 times that of the Sun. The density of the material in this star is, therefore, very small like that of the gas in an electric vacuum tube.

Fig. 2.6 Orion (Warrior)

The bright star β (Rigel) occupies another corner of Orion. It is a young star, but not so young as Betelgeuse. Rigel belongs to a group which includes the hottest of all stars.

Below the arrow or the belt of the Orion, formed by the three stars ζ, η, and δ, there are three other faint stars. θ, τ and μ. The middle one of these when seen through a large telescope, in a quadruple and discloses that it is really the Nebuls M 42 (N G C 1976) which covers the whole central part of the constellation.

(Continued on Page 49 Column 2)



Observer's Latitude 25° N

FEBRUARY
WEST
KEY-MAP

October	1 at 5	p. m. (I. S. T.)
November	1 at 3	a. m.
January	1 at 11	p. m.
February	**1 at 9**	**p. m.**
March	1 at 7	p. m.

October	15 at 4	a. m. (I. S. T.)
November	15 at 2	a. m.
January	15 at 10	p. m.
February	**15 at 8**	**p. m.**
March	15 at 6	p. m.

FEBRUARY : WESTERN SKY

Prominent Stars :

α, β in Andromeda (Alpheratz, Almach)
α in Aries (Hamal)
α in Carina (Canopus)
ο in Cetus (Mira)
β in Orion (Rigel)
α, β in Pegasus (Markab, Sheat)
β in Perseus (Algol)
α in Taurus-Hyades (Aldebaran)

Double Stars :

γ in Andromeda, gold and blue pair seen with a small telescope.
γ in Aries, with a 5 cm. telescope.
β in Perseus (Algol), an eclipsing binary known since 300 years ago. One component is dark and the other is bright, Having 2 more components it becomes a quadruplet.
ε, ζ, η in Perseus seen with a 5 cm. telescope.
φ, and ζ in Pisces, easily resolvable doubles.
α and φ in Pisces can be seen only with a large telescope.
θ in Taurus-Hyades, seen with naked eyes, a wide double.
γ in Taurus-Hyades, seen with a field glass.
η in Taurus-Pleiades (Alcyone) bright wide double. In a field glass more than 20-30 stars become visible.

Variable Stars :

ο in Cetus (Mira) variation from 1.7 to 9.6 magnitudes, having a period of 332 days.
β in Pegasus, variation from 2.2 to 2.7 magnitudes.
β in Perseus, regularly variable with a period of 2 days 20 hours and 48.9 min.
ρ in Perseus is an irregularly variable star.

Nebulae and Star Clusters :

M 31 (NGC 224) near γ in Andromeda, looks like a hazy spot. This is outside our galaxy and is receding from us.

Distance = 500,000 parsecs = 1,600,000 light-years

NGC 752 near γ in Andromeda, It is large and open.

h (NGC 869) and χ (NGC 884) in Perseus, seen with naked eyes as beautiful and bright diffuse spots.

M 76 (NGC 650) near φ in Perseus having the figure of a dumb-bell. This nebula belongs to our galaxy.

M 33 (NGC 598) in Triangulum near α can be seen with a small telescope. It is one of the nearest galaxies.

* * *

ORION

(Continued from Page 47 Column 2)

The star δ in the belt lies on the Celestial Equator.. The names of the other stars in Orion are : γ (Bellatrix), ε (Al Nilam), η (Saif), λ (Il vela) and ζ (Alnitak)

There are several legends about this constellation in Greek mythology. According to one of them, Orion was a powerful and also a beautiful warrior hunter. He was killed by an arrow flung at him by the beautiful Artemis out of jealousy. Jupiter, however, placed Orion among the constellations. In the light of this legend Orion is pictured as carrying a lion's skin in one hand and a mace in the other. A sword is shown hanging from his belt around the waist. (See fig. 2.6 on Page 47).

* * *

Observer's Latitude . 25° N.

October	1 at	5 p. m. (I. S. T.)
November	1 at	3 a. m.
January	1 at	11 p. m.
February	**1 at**	**9 p. m.**
March	1 at	7 p. m.

FEBRUARY ZENITH NIGHT-SKY

October	15 at	4 a. m. (I. S. T.)
November	15 at	2 a. m.
January	15 at	10 p. m.
February	**15 at**	**8 p. m.**
March	15 at	6 p. m.

Precession

THE PATH of the Sun in the celestial sphere on its apparent yearly journey, in relation to the stars, is called the Ecliptic. The plane passing through the Ecliptic makes an angle of 23°.5 with the celestial equatorial plane. The points where the Ecliptic and the Equatorial circle interesect are called the Equinoxes. The Sun is naturally found at the equinoxial points on two days in the year ; once on 20th or 21st March at the Vernal Equinox and again on 23rd September at the Autumnal Equinox.

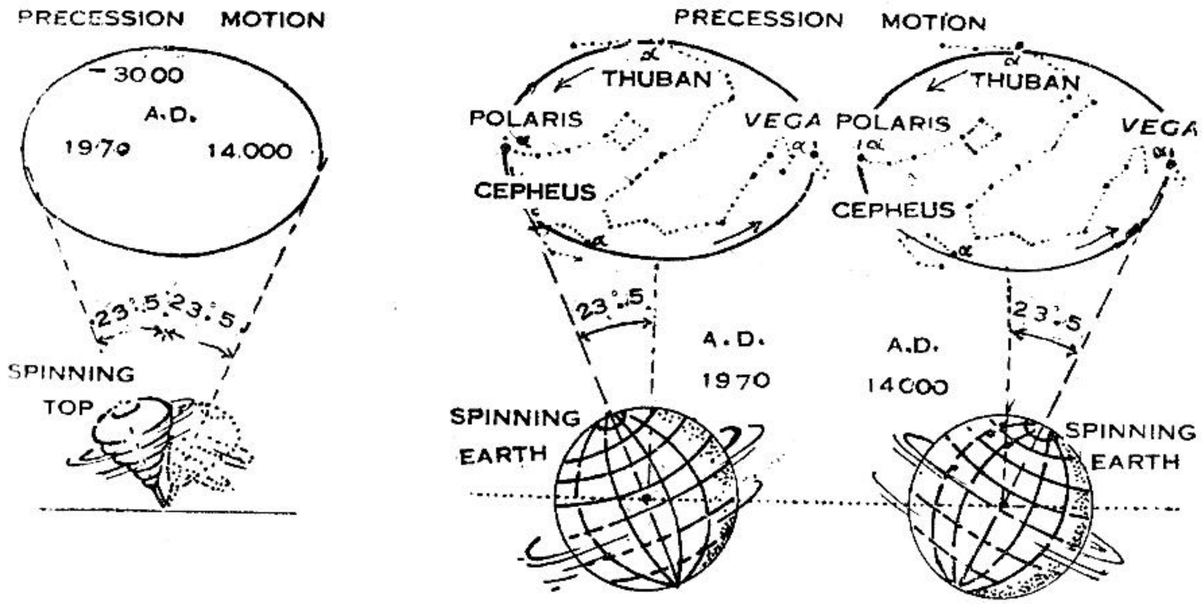


Fig. 2.7 : Effects of Precession

The Sun's position among the stars on the Equinoxial days is not fixed, but it undergoes a systematic change. This change is the result of a movement known as Precession.

Had the orientation of the Earth's axis in space been fixed, then the two equinoxial points would also have been stationary among the stars. They are observed to be shifting backwards along the Ecliptic, at is, in a direction opposite to that of the Sun's motion. The shifting movement is slow at the rate of about 50″ per year. This shifting is technically called the Precession.

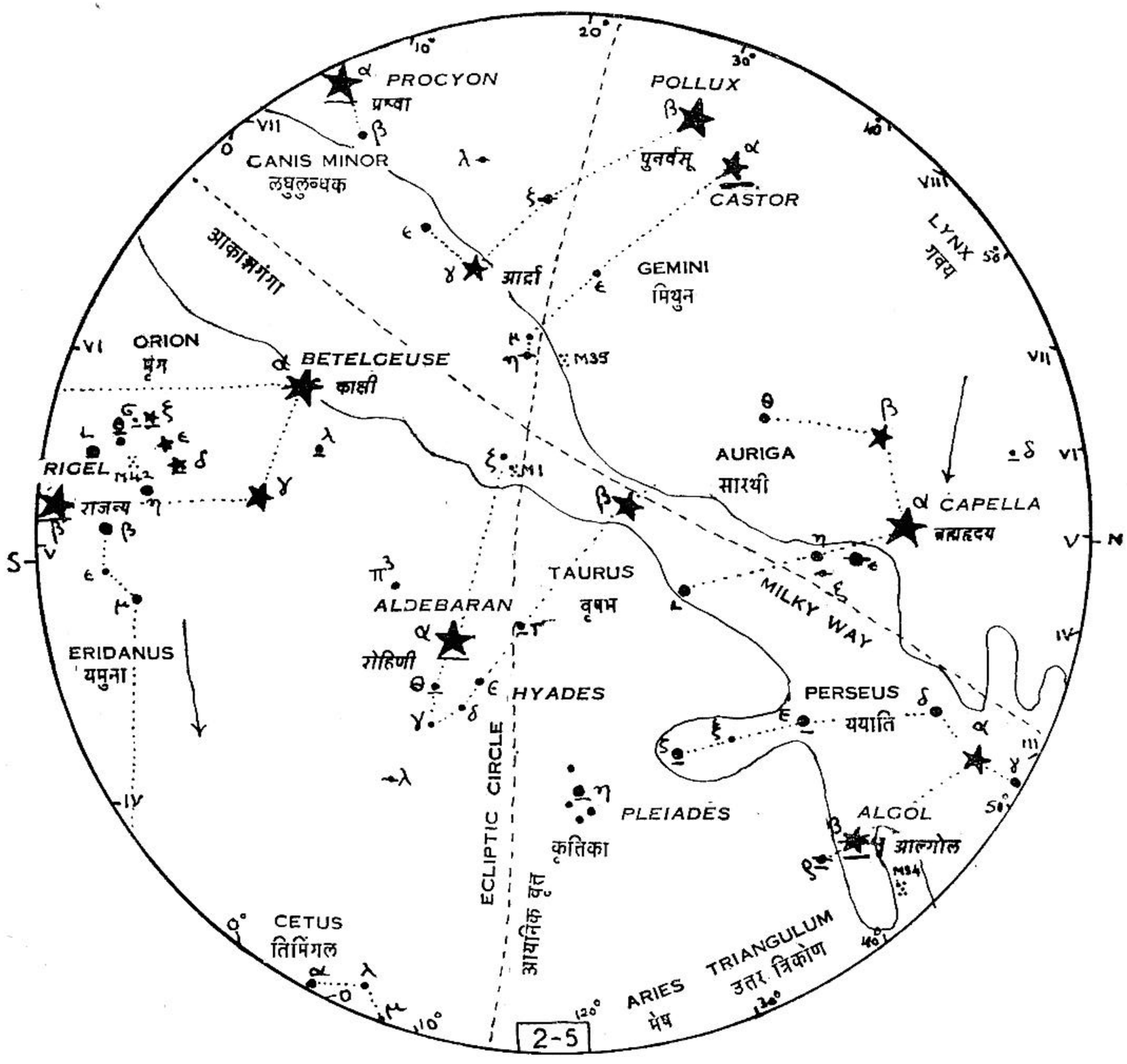
The cause of this movement can be seen in the wobbling motion of spinning top. The earth is not a true sphere. Its equatorial diameter is greater than the polar diameter. We can, therefore, regard the shape of the earth as a sphere with a super-imposed shell which is thickest at the equator and extremely thin at the poles. Had the Earth been a true sphere, the Sun's attraction would naturally be directed exactly at the centre of the earth. But owing to the non-spherical shape of the Earth the Sun's attraction is made up of two forces, one acting through the centre of the earth and the other through some point away from the centre. The joint action of these two forces is that of a force-couple which tends to tilt the Earth's axis somewhat from its normal position. The tilt causes the axis to spin slowly about a mean position. The spinning Earth thus behaves like a spinning top, a gyroscope. The earth's axis consequently comes to describe a cone about the Pole of the Ecliptic, and the result is seen in the slow movement of the north celestial pole describing a circle of 23°.5 round the Pole of the Ecliptic.

The shifting of the equinoxial points is one consequence and the shifting of the position of the Celestial Pole is another. At present the Celestial Pole is very near the Pole Star as we call it. The star is Polaris is (α of Ursa Minor) and it is actually 1° 2′ away from the true Celestial Pole. We call this star the Pole Star. It can be realised, however, that different stars on the circle described by the earth's axis will obtain the status of a pole star in their own time.

Round about the days of the Egyptian Pyramids, about 3000 B. C., the earth's axis passed near star Thuban (α of Draco). This star was, therefore, the Pole Star at that time. The Precession Circle is completed in 26,000 years, so that after the lapse of 26,000 years, the present Pole Star will again resume its status.

In the meanwhile, sometime about the year 14,000 A. D., the bright star Vega (α of Lyra) will become the Pole Star.

* * *



Observer's Latitude 25° N

FEBRUARY ZENITH KEY-MAP

October	1 at 5 p. m. (I. S. T.)	
November	1 at 3 a. m.	
January	1 at 11 p. m.	
February	**1 at 9 p. m.**	
March	1 at 7 p. m.	

October	15 at 4 a. m. (I. S. T.)
November	15 at 2 a. m.
January	15 at 10 p. m.
February	**15 at 8 p. m.**
March	15 at 6 p. m.

Dwarf Stars

RELATIVELY FAINT stars have to be fairly near us to be observable. Faint stars are called Dwarf Stars. There are two kinds of Dwarfs, red and white. They are so named on account of the special kinds of spectra of their radiations. There appear to be very few Red Dwarfs. So far only a few hundred have been properly identified.

Stars of the White Dwarf variety are relatively common. They have an extremely high density. The small companion of Sirius is a good specimen of a White Dwarf star. Its mass is almost the same as that of the Sun, but its diameter is only about four times that of the Earth. Large mass and small volume make the density of the material in the White Dwarf nearly 40,000 times that of water. It is possible that the material of which the white star is made is not in the form of atoms and molecules, but it is first broken down into loose nuclei and electrons and then recombined in a new type of compact formation unknown to us and not found in other types of stars.

Giant Stars

THESE ARE stars of very great luminosity and possess large superficial area. Capella and Arcturus are good examples of Giants. When a star has an unusually great luminosity it is called a Supergiant. Rigel, Betelgeuse, Antares are Supergiants.

According to Hertzsprung, stars can be divided into two groups faint stars with absolute magnitudes from + 5 to + 10, and very bright stars of absolute magnitude + 2 to − 2. These bright stars are known as Giants and Supergiants respectively. They are bright red and have very large diameters. (See Page 61 Column. 2)

Giants and Supergiants are surrounded by expanding gas envelopes. One component of the visual double star α in Hercules is a star of this type. Its gas envelope has a thickness of 1000 astronomical units. (AU = the distance of the Sun from the Earth), and expansion is going on with a speed of about 10 Km. per second. Hydrogen is being repelled by the radiation emitted by the star. As compared with Giants, Sun is a small star, where the Hydrogen atoms are not driven out and off, because there the gravitation is more powerful.

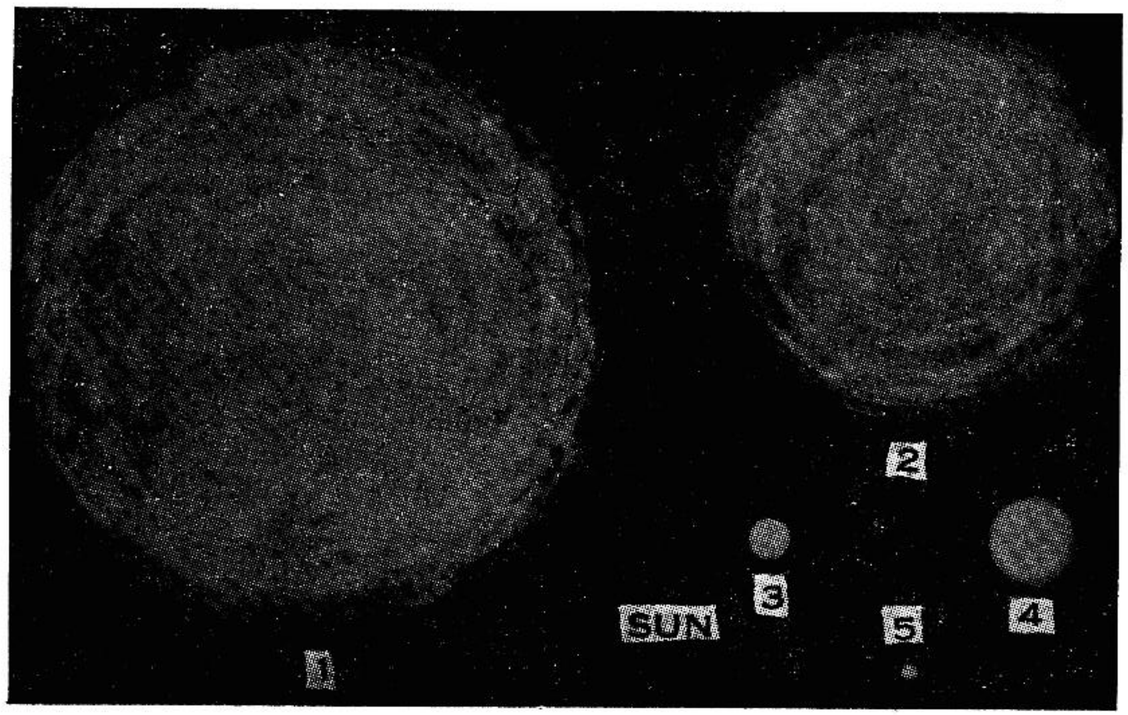
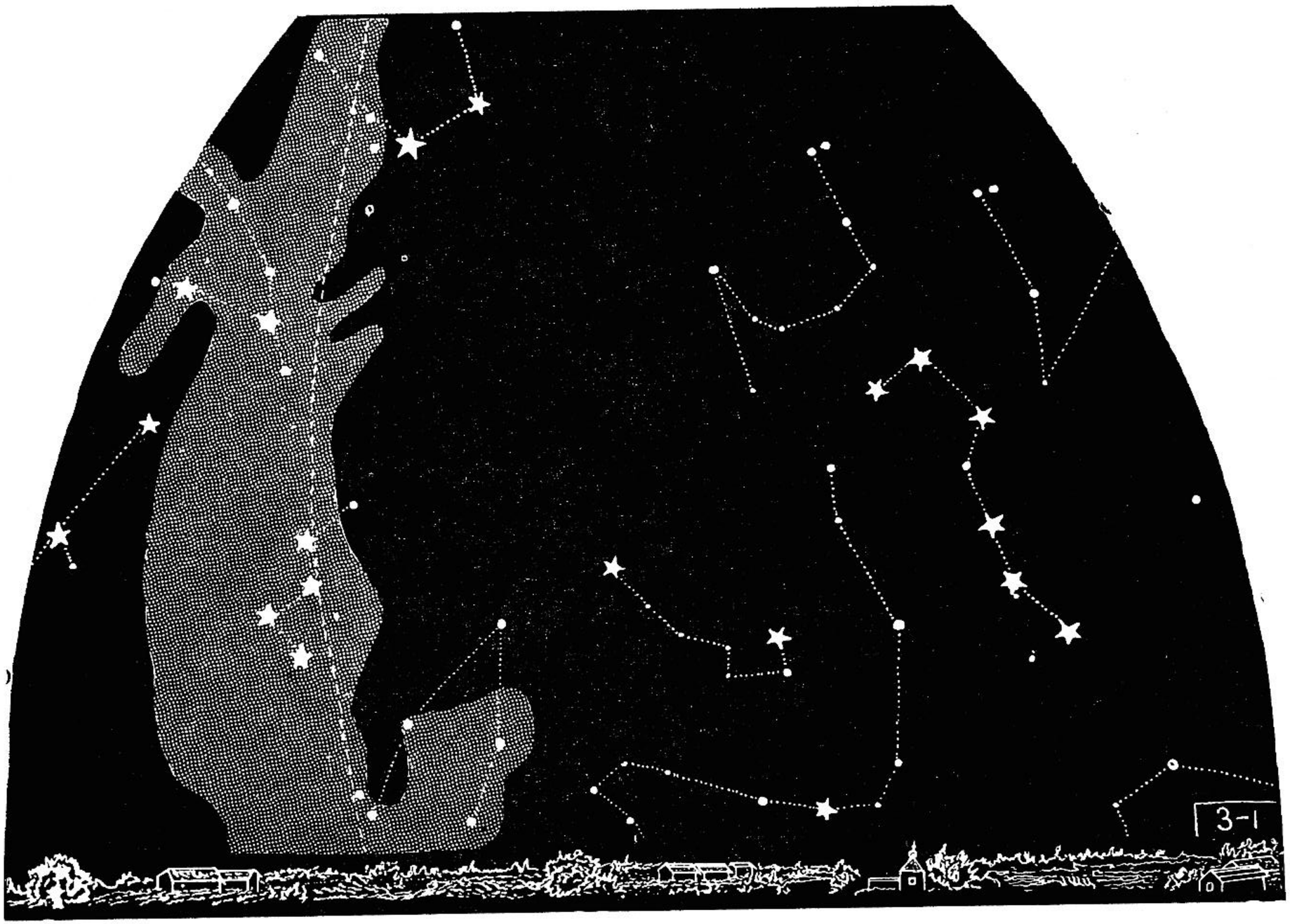


Fig. 2.8 : Dwarfs and Giant stars

1. α in Auriga
2. α in Pegasus
3. α or Capella in Auriga
4. α or Arcturus in Bootes
5. γ in Cygnus

Sun. Approximately the size of a full stop.

* * *



Observer's Latitude : **25°N**

MARCH
NORTH
NIGHT-SKY

November	1	at	5 a. m.	(I. S. T.)	November	15	at	4 a. m.	(I. S. T.)
December	1	at	3 a. m.		December	15	at	2 a. m.	
February	1	at	11 p. m.		February	15	at	10 p. m.	
March	**1**	**at**	**9 p. m.**		**March**	**15**	**at**	**8 p. m.**	
April	1	at	7 p. m.		April	15	at	6 p. m.	

Lynx

THIS IS an inconspicuous constellation of the northern hemisphere and it is formed by a few stars irregularly scattered between Ursa Major, Auriga, Cancer and Gemini. None of the stars is remarkable in any way. The nomenclature is modern.

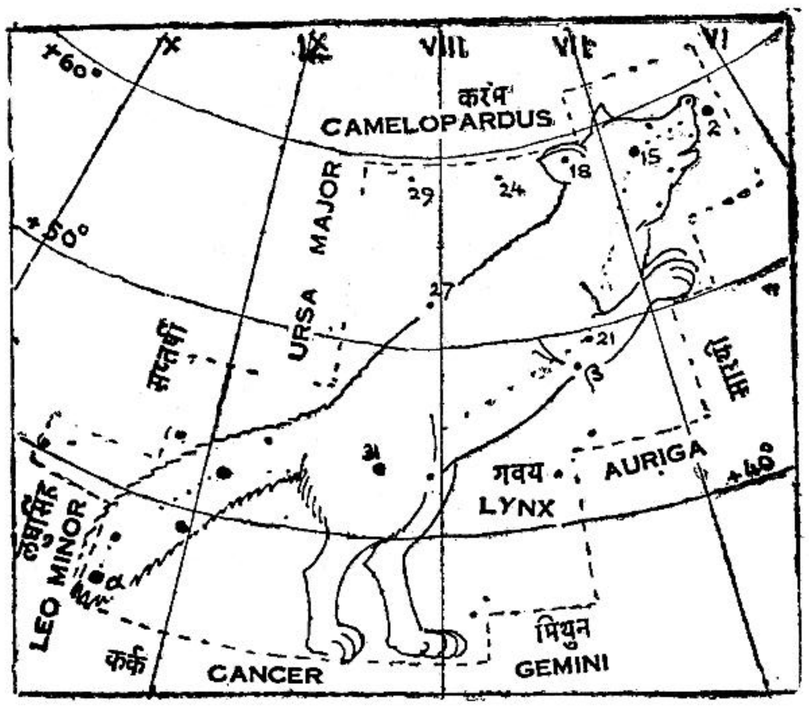


Fig. 3.1 : Lynx

According to mythology, the Greek Goddess (Ceres) deputed an expert down to the earth to teach mankind the science of Agriculture. A certain king, not appreciating the situation, attempted to murder the expert in a treacherous manner. To commemmorate this incident, the Gods transformed the treacherous king into a Lynx and placed him in the sky. The Lynx is an animal of the cat tribe with tufted ear-tips, short tail, spotted fur and keen sight. But the animal is treacherous. Hence the nomenclature.

* * *

Orion and the Arctic Home of the Aryas

In ancient times, time could be reckoned only by observing the stars in the vicinity of the Sun, either in the early morning a little before sunrise, or in the evening a little after sunset. It was customary, therefore to describe the position of the Sun against the background of the stars with reference to corresponding constellation.

At the present time, the Vernal Equinox occurs when the Sun is in the constellation Uttarā Bhādrapadā, which corresponds to Zodiacs, Pisces and Aquarius (Mīna and Kumbha)

According to Lokamānya B. G. Tilak who published his researches on the dates of the Vedas in his book Orion, the group of stars, that we know today as Orion, was called *Agrahāyaṇī* (अग्रहायणी) in Vedic times. It is contended that the European name Orion must have been derived from this ancient name. An attempt is made to fix the age of the Vedas from various astronomical references in the texts. In the light of "Precession of the Equinoxes'* he concludes that the Vernal Equinox had occurred, ages ago, in Orion (*Mṛga*) at about 4500 B.C. On the basis of this finding he has worked out the dates of some other ancient texts and events as follows :

Ṛgveda	About 5000 B.C.
(Egyptian Pyramids)	About 3000 B.C.
Taittīriya Samhitā	About 2000 B.C.
Vedāṅga Jyotiṣa	About 1200 B.C.

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* See Precession of Equinoxes on Page 51.

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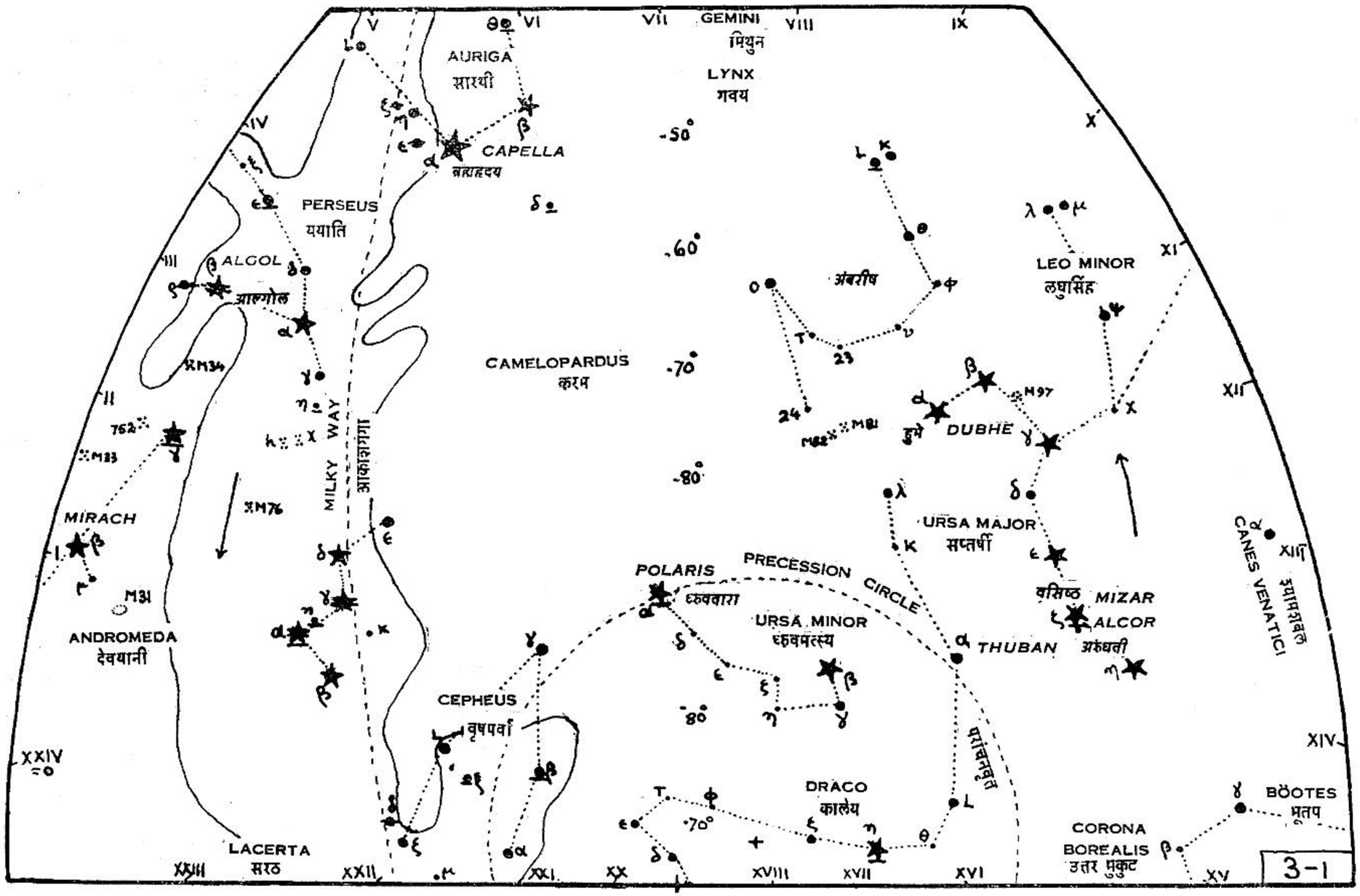

Observer's Latitude : 25°N

MARCH
NORTH
KEY-MAP

November	1 at 5 a. m. (I. S. T.)	November	15 at 4 a. m. (I. S. T.)
December	1 at 3 a. m.	December	15 at 2 a. m.
February	1 at 11 p. m.	February	15 at 10 p. m.
March	**1 at 9 p. m.**	**March**	**15 at 8 p. m.**
April	1 at 7 p. m.	April	15 at 6 p. m.

MARCH : NORTHERN SKY

Prominent Stars :

- α in Auriga (Capella).
- β in Perseus (Algol).
- α in Canes Venatici (Cor Caroli).
- α, β in Cassiopeia (Shedir and Caph) on Hour–Angle XXIV.
- α in Draco (Thuban), former Pole Star.
- α, β in Ursa Major (The Pointers).
- ζ in Ursa Major (Mizar) with companion (Alcor).
- α in Ursa Minor (Polaris), present Pole Star.

Double Stars :

- β in Perseus, eclipsing binary, known since 300 years ago. One dark and one bright component. There are 2 more components making this a quadruplet.
- ε, ζ, η in Perseus, seen with a 5 cm. telescope, has yellow and blue components.
- α in Canis Minor. Companion is faint and white dwarf.
- η in Cassiopeia, seen with a 5 cm. telescope, period 526 years.
- ζ in Ursa Major seen with a 5 cm. telescope. There is another star Alcor, very close and seen with naked eyes.
- α in Ursa Minor, wide double, bluish components, seen with a 5 cm. telescope.

Variable Stars :

- δ in Cepheus, partners of magnitudes 3.6 and 4.2 and a period of 5.37 days.
- ε, ζ in Auriga, eclipsing variables of periods 9883 and 972 days respectively.
- β in Perseus, regularly variable, periods 2 days 20 hours 48.9 minutes.
- ρ in Perseus is an irregularly variable.

Super Nova :

There appeared in Cassiopeia in 1572 A. D. a Super Nova, which was as bright as Venus and could be seen by day. In 1574 A. D. it ceased to be visible.

Nebulae and Star Clusters :

- M 35 (NGC 2168) above μ and η in Gemini, beautiful and seen with naked eyes.
- M 96 (NGC 3368) in Leo between α and β. Spiral Nebula seen with field-glass.
- M 76 (NGC 650) in Perseus near ϕ. Dumb-bell shaped and belonging to our galaxy.
- M 81 (NGC 3031) and M 82 (NGC 3034) in Ursa Major near latitude 70° N. Both can be seen together with a low power telescope.
- M 97 (NGC 3587) in Ursa Major between β and γ.

* * *

Lacerta

THIS IS an inconspicuous constellation in the northern hemisphere between Andromeda and Cygnus. It contains no star brighter than magnitude 4. A Nova had appeared in this star-group in 1936 A. D. and it had reached a brightness of magnitude 1.9. The nomenclature is modern and it merns the Lizard.

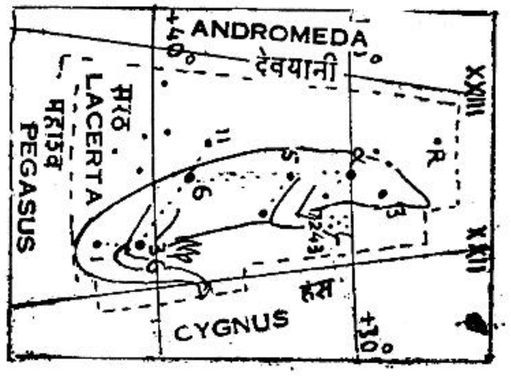

Fig. 3.2 : Lacerta

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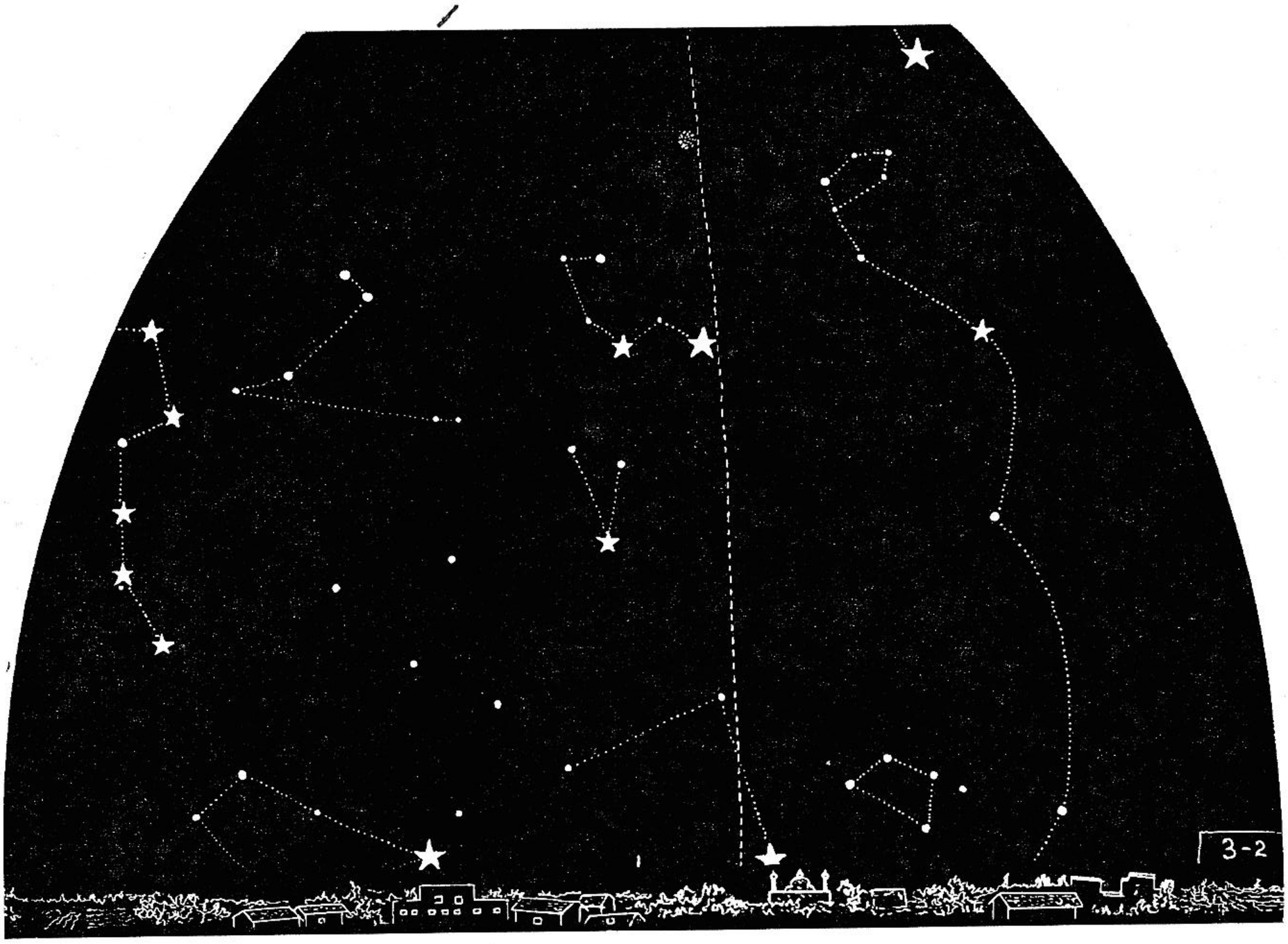

Observer's Latitude : 25°N

MARCH
EAST
NIGHT-SKY

November	1 at	5 a. m. (I. S. T.)	November	15 at	4 a. m. (I. S. T.)
December	1 at	3 a. m.	December	15 at	2 a. m.
February	1 at	11 p. m.	February	15 at	10 p. m.
March	**1 at**	**9 p. m.**	**March**	**15 at**	**8 p. m.**
April	1 at	7 p. m.	April	15 at	6 p. m.

Coma Berenices

THIS IS a group of many faint stars, situated in the eastern sky, between Virgo and Canes Venatici. The constellation was formerly considered inconspicuous but it has now become famous through the discovery of a large number of spiral nebulae in the region, which can be seen only through a telescope.

According to the former pictorial representation of the constellation Leo, the faint stars in Coma Berenices were merged in it. These stars formed the tuft of the tail of the Lion and the starting point of the Lion's tail was the bright star Denebola (β). Regulus (α) the brightest star stood at the Lion's heart. Later, it was discovered that Denebola is 25 light years away from us, while Regulus is about 99 light years. With this new information about their distances, it did not seen fair to treat them as constituents of one single constellation. We have, therefore, Leo and Leo Minor as two separate constellations. The tuft of the tail consequently became a new constellation and Tycho Brahe, the famous astronomer, named this new constellation, in 1602 A. D., Coma Berenices. This name, meaning the Queen's Hair, was chosen to please the vanity of an Egyptian Queen as far back as 3rd century B. C. With this nomenclature, evidently, the erect tail of the lion, containing in its tuft Coma Berenices, is now curled up and Denebola represents the tuft.

The ancient legend of the Egyptian Queen's hair is quite interesting and meaningful. Her husband had gone away on a dangerous and prolonged campaign. The Queen, out of anxiety and for the safety of the King, offered the beautiful and flowing locks of her hair to the Gods in the temple of Venus. When eventually the King returned to Egypt, safe and victorious, the Queen cut her long hair and hung them in the temple. During the ensuing night, the hair were unfortunately stolen from there. The legend assures that Venus was satisfied with the sacrifice but the Queen felt sad about the theft. The beautiful explanation was given later that Venus had appreciated the offer and placed the Hair among the stars. Nomenclature Coma Berenices gave the additional proof.

All stars in this constellation are faint. The double stars Nos. 24, 35 and 42 can be seen through a telescope.

M 100 (NGC 4321) is a beautiful Nebula to the South of star 11 and it is visible through a field glass.

The globular cluster M 53 (NGC 5024) above star 42 can also be seen through a small field glass.

Some 75 faint stars, of magnitudes ranging from 4.5 to 10, are moving together as a group towards the west. They are about 320 light years away from us.

The Galactic Pole of the Milky Way lies in Coma Berenices and its position is indicated as Hour—Angle 12 h. 40 min. and declination 28° N.

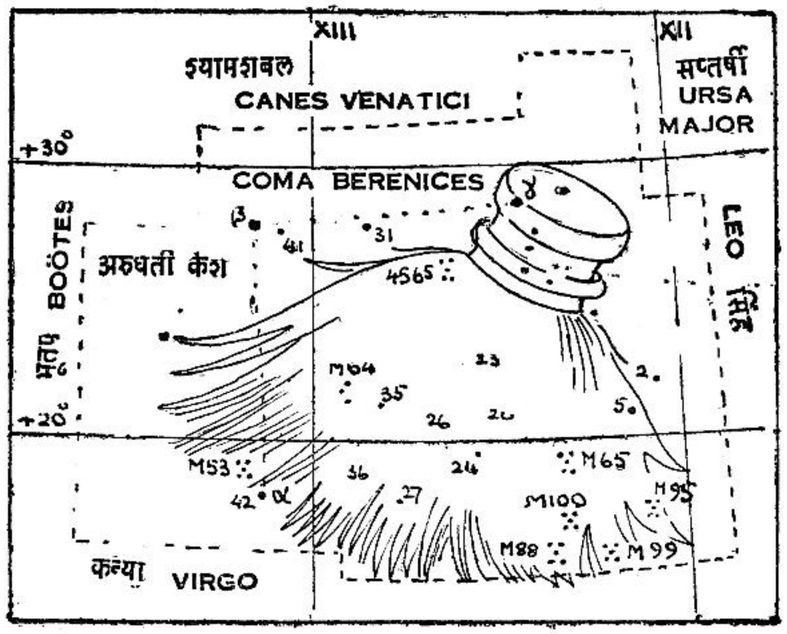

Fig. 3.3 : Coma Berenices.

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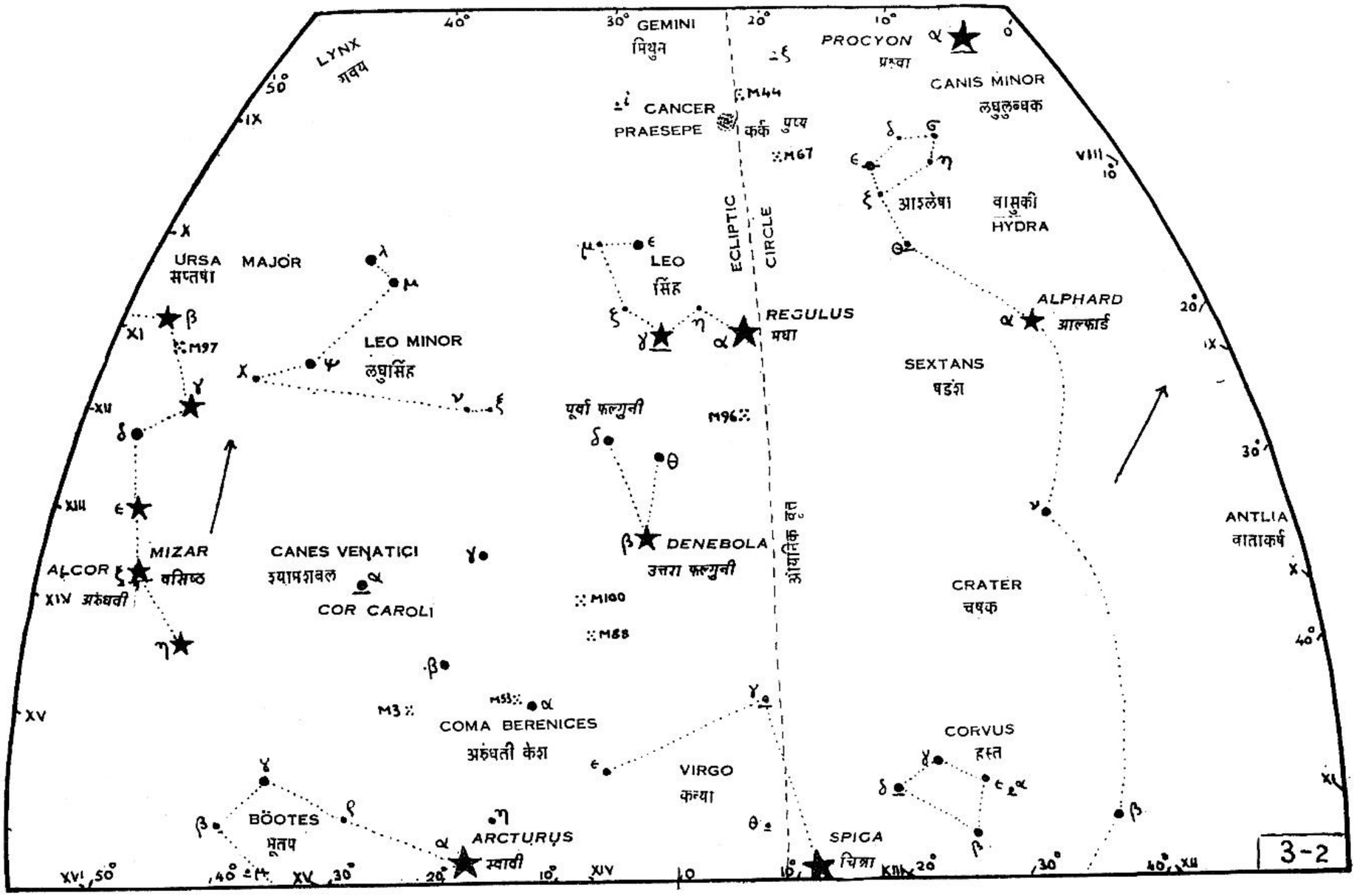

Observer's Latitude : 25° N

MARCH
EAST
KEY - MAP

November 1 at 5 a. m. (I. S. T.)
December 1 at 3 a. m.
February 1 at 11 p. m.
March 1 at 9 p. m.
April 1 at 7 p. m.

November 15 at 4 a. m. (I. S. T.)
December 15 at 2 a. m.
February 15 at 10 p. m.
March 15 at 8 p. m.
April 15 at 6 p. m.

MARCH : EASTERN SKY

Prominent Stars :

- α in Bootes (Arcturus) near the horizon.
- α in Canis Minor (Procyon).
- α in Hydra (Alphard), about one third of its length below the Snake's head.
- α in Leo (Regulus).
- β in Leo (Denebola).
- α, β in Ursa Major (The Pointers).
- ζ in Ursa Major (Mizar) with its neighbour Alcor.
- α in Virgo (Spica) near the horizon.

Double Stars :

- α or 12 in Canes Venatici (Cor Caroli), seen with a 5 cm. telescope.
- γ in Bootes 2 bright components, seen with a 5 cm. telescope.
- γ in Leo seen with a 2" telescope, orbital period 619 years.
- ζ in Ursa Major. This is a 5 cm. telescope double and it has another companion Alcor which can be seen with naked eyes. A test for good eyesight.

Nebulae and Star Clusters :

- M 44 (NGC 2632) and M 67 (NGC 2682) in Cancer are rewarding sights in a small telescope.
- M 3 (NGC 5272) under star 25 or Canes Venatici, open brilliant Cluster, seen with naked eyes.
- M 53 (NGC 5024) in Coma Berenices, globular cluster, seen with a field glass.
- M 100 (NGC 4321) in Coma Berenices. South of star 11, seen with a field glass.
- M 96 (NGC 3368) in Leo between α and β. Spiral nebula, seen with a field glass.

* * *

Hertzsprung Russel Diagram

The stars appear in different colours mainly because of the different surface temperatures. The surface temperature, the rate of emission of light energy from the star and its distance from us on the Earth determine the absolute magnitude of a star. This is shown on the ordinate of the accompanying diagram.

Blue Giants and Red Dwarfs are found near the upper and lower side of the inclined line, respectively. Super Giants are very large in size, but their surface temperatures are not high. The white Dwarfs are small in size but their surface temeperatures are extremely high.

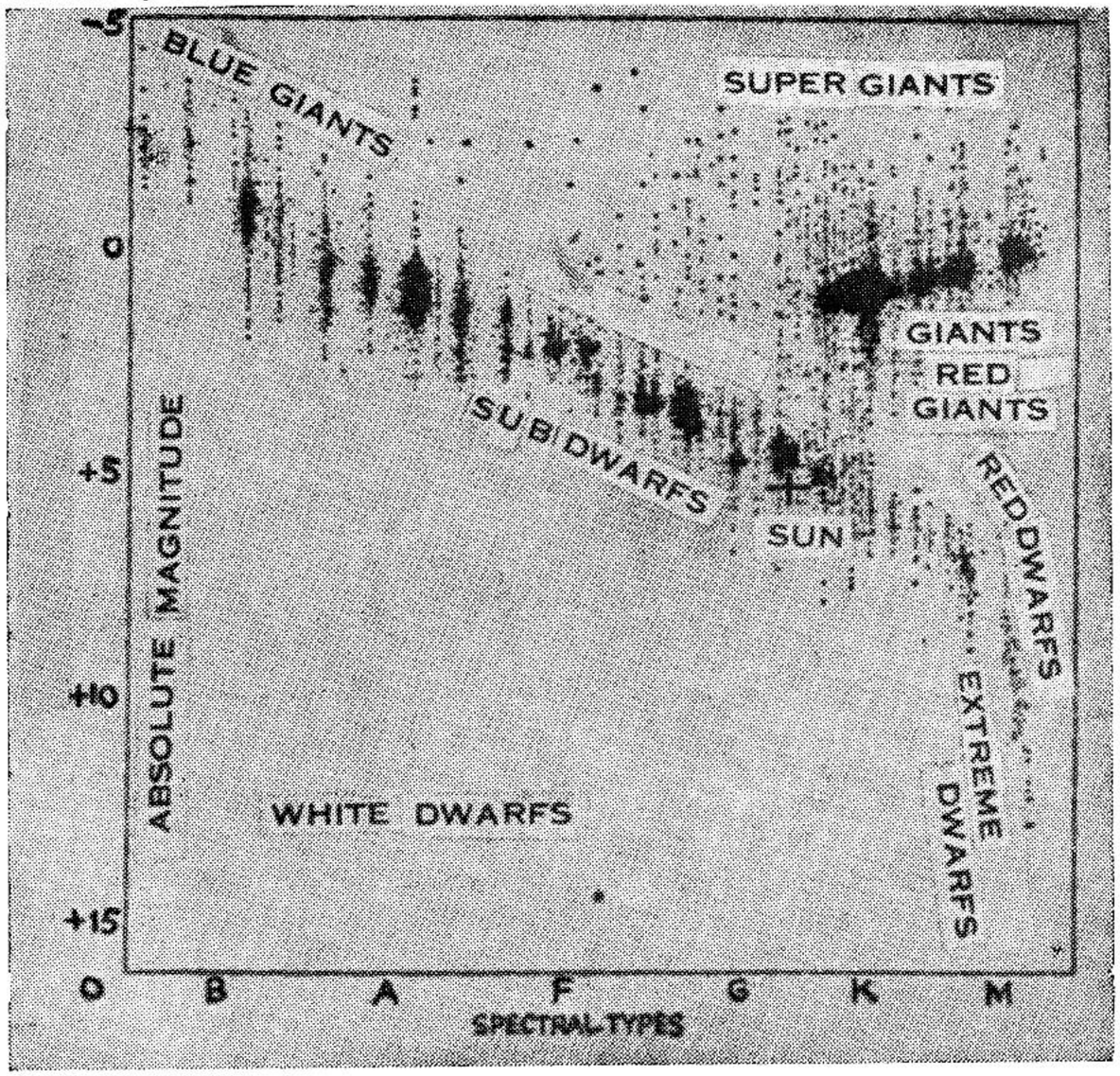

Fig. 3.4 : Types of stars in Herztsprung—Russel diagram.

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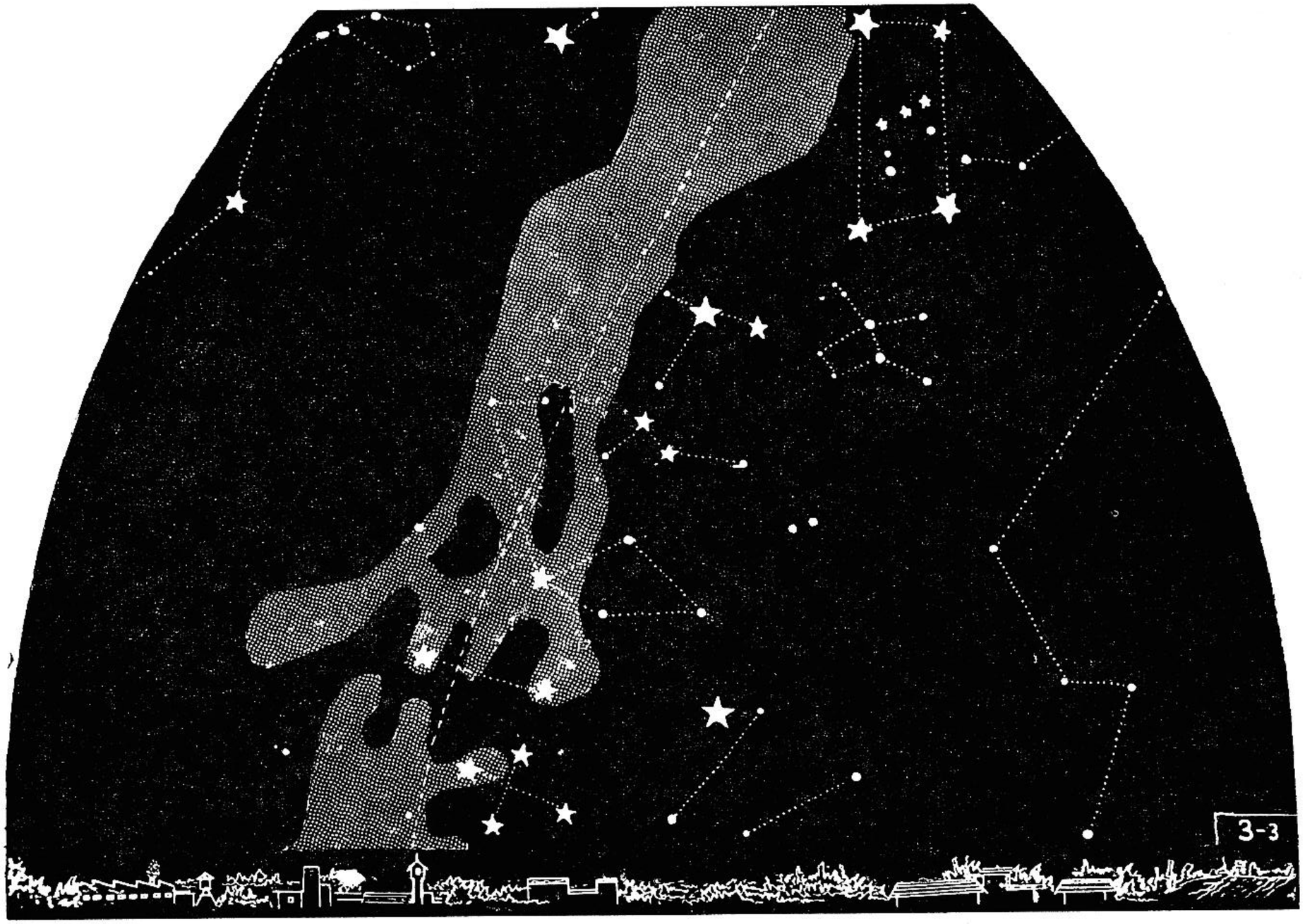


Observer's Latitude : 25° N

MARCH
SOUTH
NIGHT-SKY

November	1 at	5 a. m. (I. S. T.)	November	15 at	4 a. m. (I. S. T.)
December	1 at	3 a. m.	December	15 at	2 a. m.
February	1 at	11 p. m.	February	15 at	10 p. m.
March	**1 at**	**9 p. m.**	**March**	**15 at**	**8 p. m.**
April	1 at	7 p. m.	April	15 at	6 p. m.

Argo

ARGO USED to be the name of a very extensive constellation of the southern hemisphere. Now, for the sake of convenience, the entire constellation is split up into four separate parts and these parts are called ; (1) Carina, the Keel ; (2) Puppis, the Stern ; (3) Vela, the Sail ; and (4) Pyxis, the mariner's Compass. The choise of these names lies in the fact that the original constellation was called Argo, a Ship mentioned in ancient Greek mythology.

The constellation Argo lies generally to the South of the inconspicuous constellation of Monoceros, and the well-known constellation Canis Major with its bright star Sirius.

According to Greek Mythology, this constellation was previously the ship Argo that undertook to obtain the Golden Fleece from some place on the Black Sea where it was kept. This fifty-oared ship was built in about 936 B. C. and several heros from Greece nad joined the expedition. This adventure came to be known later as the Argonautic Expedition.

There are many different legends about Argo in ancient literature, but most of them are connected with the Deluge.

According to Indian mythology, King *Manu* (मनु) handed over the duties of the state to his son and went away to practice penance on a mountain. *Brahmadeva* (ब्रह्मदेव) was pleased with the King *Manu* and endowed him with the supernatural power that " if ever a deluge should occur the ability to save everything from destruction would be vested only in the King ". Afterwards when *Manu* was offering homage to his dead ancestors, a *Śafarī* (a small glittering fish) fell into his open palms and began to grow in size. Finally it became so large that no well, no pond, no river was big enough to accommodate the animal. *Manu* finally threw the animal into the sea. According to the narrative,

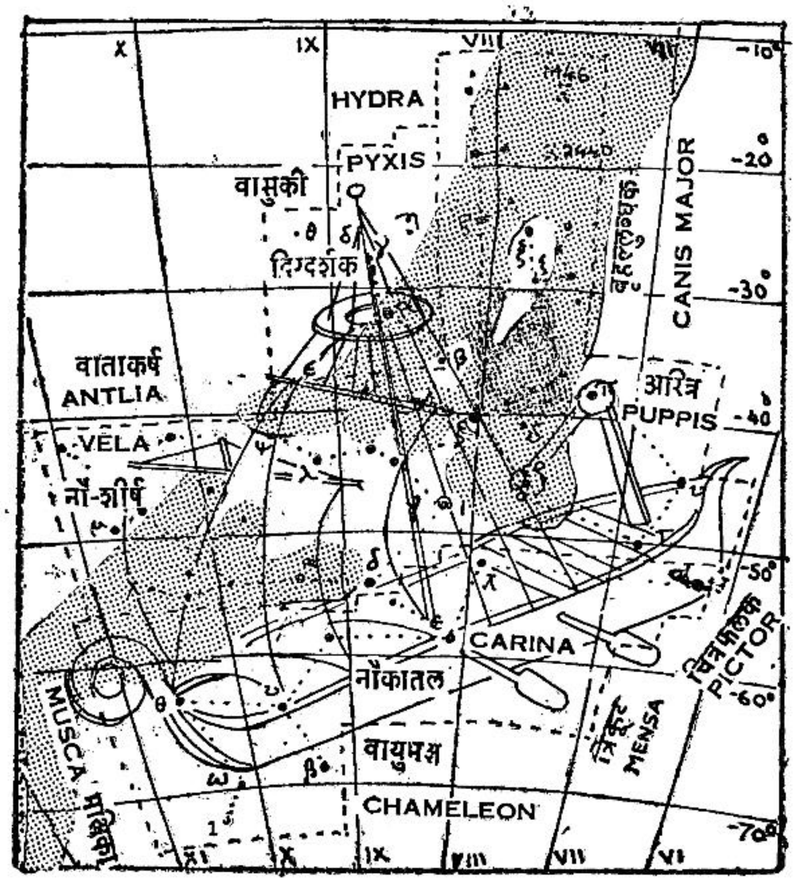
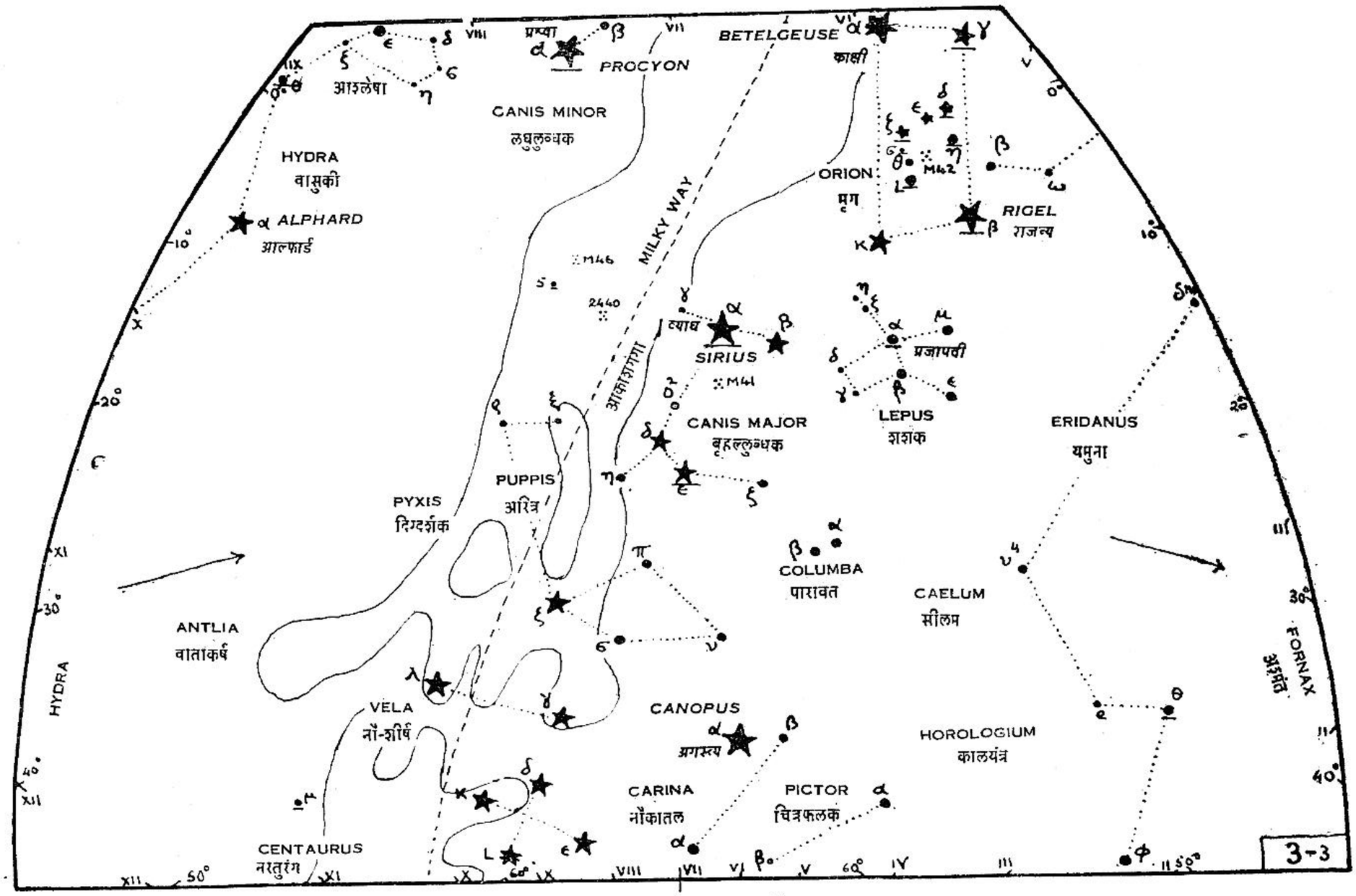


Fig. 3.4 : Argo Navis

the fish *Śafarī* was actually the God in disguise. He gave *Manu* a Ship and directed him to make use of it whenever the deluge would occur. The deluge did occur within a week and *Manu* could take all living animals in that ship to a place of safety. Just about that time a Snake came floating in the sea. *Manu* used it as a rope and the Ship was fastened with it to the horns of the *S'afarī*. In this manner *Manu* used his power to save everything from destruction. We can see the constellations mentioned above, namely Argo, and Hydra, in the pictorial representation.

The Chaldeans tell a similar story but in a slightly different way. Tamazi, the son of Ubertutu, was very well behaved. Later on when the human race became morally depraved, God brought about the deluge, so that the entire race could be destroyed. But God managed to save only Tamazi and his family by placing them in a ship. When the ship

(Continued on Page 65 Column 2



Observer's Latitude 25° N

MARCH
SOUTH
KEY MAP

November	1 at	5 a.m. (I. S. T.)	
December	1 at	3 a.m.	
February	1 at	11 p.m.	
March	**1 at**	**9 p.m.**	
April	1 at	7 p.m.	

November	15 at	4 a.m.	(I. S. T.)
December	15 at	2 a.m.	
February	15 at	10 p.m.	
March	**15 at**	**8 p.m.**	
April	15 at	6 p.m.	

MARCH : SOUTHERN SKY

Prominent Stars :

α in Canis Major (Sirius)
α in Canis Minor (Procyon)
α in Carina (Canopus)
α in Hydra (Alphard)
α in Lepus on the western side of the Sirius.
α, β in Orion (Betelgeuse and Rigel).
λ and γ in Vela, in line with Canopus.

Double Stars :

θ in Hydra, object for a 7.5 cm. telescope.
α in Canis Minor. Companion is 10th magnitude star of the white dwarf type.
α in Canis Major, companion is faint and of magnitude 10. The type is a white dwarf and of extremely high density.
θ_1, θ_2, δ in Orion, seen with a binocular.
β in Orion, 202″ apart and seen with a 5 cm. telescope.
θ_1 in Orion can be resolved into 4 stars forming a trapezium seen with a 5 cm. telescope.
i, λ, σ in Orion are all binaries.
α in Lepus, seen only with a good sized telescope.

Variable Stars :

L in Carina, in the ' Cross-like ' grouping near the horizon.
R in Lepus is a good sight and is called Hind's crimson Star.
α in Orion, irregularly variable.

Nebulae and Star Clusters :

M 41 (NGC 2287) in Canis Major, about 5° below Sirius, visible with naked eyes.

M 42 (NGC 1976) in Orion below σ in the belt, Great Orion Nebula, seen with naked eyes.

diameter = 30 parsecs = 100 light-years
distance = 400 persecs = 1300 lght-years

M 46 (NGC 2437 and NGC 2422 in Puppis on the same latitude as Sirius. Both are beautiful clusters seen through field glasses.

ARGO

(Continued from Page 63)

reached a mountain on the coast, Tamazi stepped out of it, performed a sacrifice with the object of ending the deluge and saving the human race from total destruction. This noble action on the part of Tamazi was much appreciated by the Gods, who placed him and his Ship in the sky as a constellation, Argo.

The Persian astronomer Al Sufi, about the 10th century A. D., mentions quite a different legend in this connection. According to him, Procyon, the Little Dog, and Sirius, the Large Dog, had another brother by name Canopus. (Canopus is the brightest star of Carina in Argo). When Canopus married a princess by name Rigel and afterwards killed her, Sirius the Large Dog chased him towards the south. In this manner Canopus became a bright star of the southern hemisphere.

* * *

Puppis

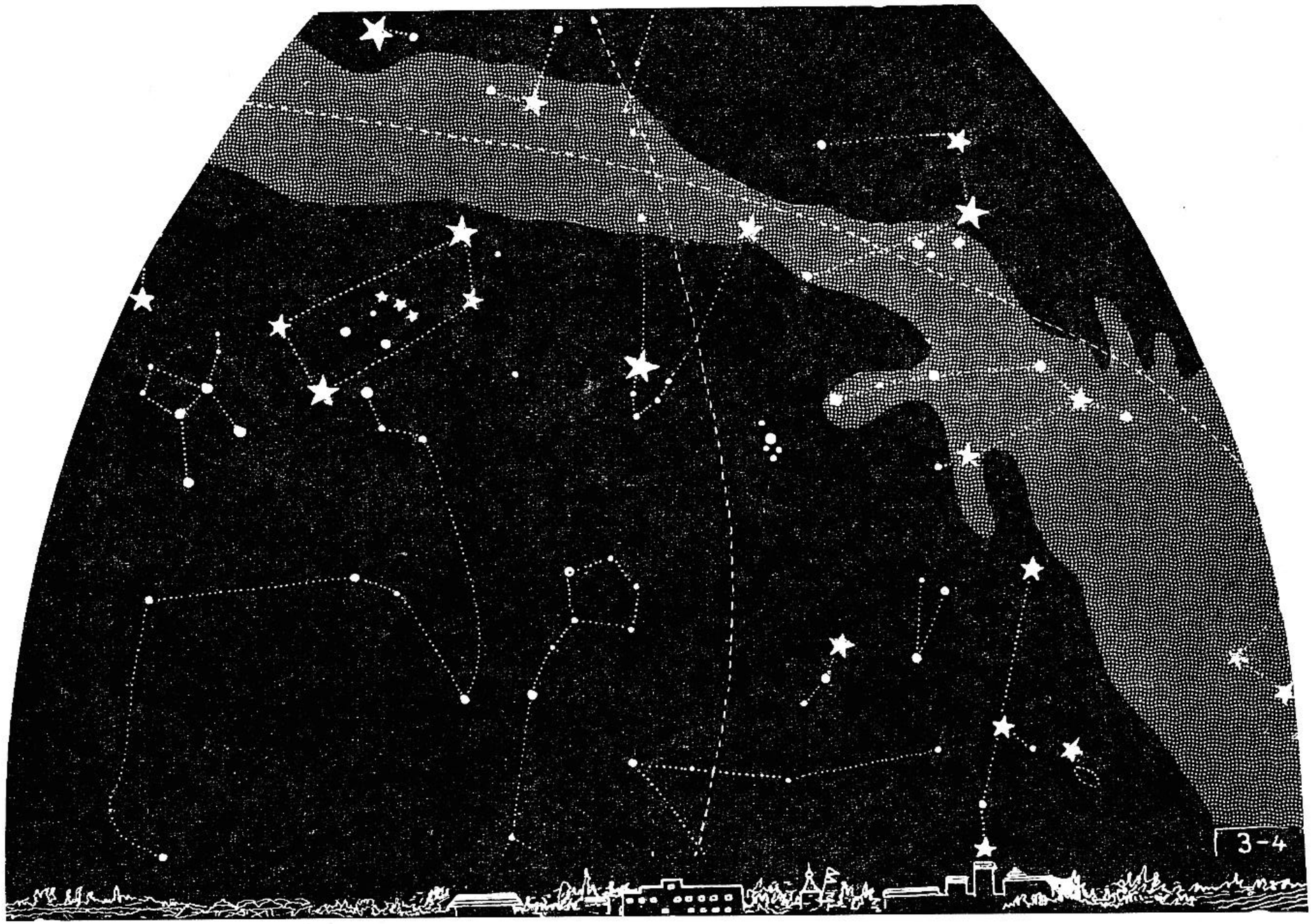
THIS IS a part of the former constellation Argo, the ship. Puppis means the stern of the ship. (See Fig. 3.5 on Page 63) The nomenclature is new and the constellation lies to the east of Sirius and to the north of Canopus.

The bright star ζ (Naos) of Puppis is of magnitude 2.3. It is very hot and is considered as belonging to the Wolf Rayet type. These stars are extremely hot and are therefore surrounded by rapidly expanding envelopes of gas. There are about 100 stars of this type known so far. Spectroscopic examination indicates that such a star consists mainly of ionized Helium. Measurements have revealed that these stars have velocities of the order of 3000 Km. per second.

Star 5 in Puppis is a double and it provides a good test for a 5 cm. telescope.

Another star V is found to be a double of the Algol type. The variation in brightness has a period of only 1.5 days and it is believed to be its whirling so close to its companion that both appear to be almost in actual contact.

* * *



Observer's Latitude 25° N

MARCH
WEST
NIGHT-SKY

November	1 at 5 a.m. (I. S. T.)	November	15 at 4 a.m. (I. S. T.)
December	1 at 3 a.m.	December	15 at 2 a.m.
February	1 at 11 p.m.	February	15 at 10 p.m.
March	**1 at 9 p.m.**	**March**	**15 at 8 p.m.**
April	1 at 7 p.m.	April	15 at 6 p.m.

Carina

CARINA MEANS the keel and it is the southern part of the former constellation Argo (See Fig. 3.4 (Ship) on Page 63).

The principal star Canopus is very bright, being of magnitude — 0.9. At 8 p. m. in the middle of March, this star is well above the horizon and situated slightly to the right (West) of the direction which is due South. Canopus can be recognized easily, since at this time it lies South of Sirius and at nearly the same distance as Procyon of Canis Minor and Betelgeuse of Orion appear from it.

Other stars in the neighbourhood of Canopus are δ and k of Vela, the Sail of the Ship; and β and *i* of Carina, the keel of the ship. These stars make up the figure which has come to be called the " pseudo Cross ". It resembles the wellknown constellation Crux or the Southern Cross. (See Crux : Page 103)

The star *l* of Carina, in the pseudo Cross, is a variable, changing from magnitude 3.6 to 5 and back, with a period of about 35.5 days. The neighbouring star R of Carina is also a variable with a period of 309 days. When this star becomes bright its magnitude is 4.5 and when faint it is as little as 10.0, remaining invisible to the naked eye.

Great interest centres round the star η of Carina. It was seen as a 4th magnitude star in 1677 A. D. by Halley. In 1814 it had become a second magnitude star. In 1827 again it became very bright reaching magnitude 1. Afterwards for about five more years its brightness rose further to magnitude 0 in the year 1838. At this time it looked almost as bright as Rigel in Orion. Later on it faded somewhat and again reached magnitude — 1.0, almost that of Canopus. From that maximum it declined till it became invisible to the naked eye in about 1866-68 A. D. and since that time the star has not changed its brightness.

There is a nebula about this star and its distance from us is about 2500 light-years.

Star Canopus is called *Agastya* (अगस्त्य) in Indian mythology and there are several legends about it. According to one, Agastya was a great sage and he had made his abode in South India as a representative of the ancient Aryan culture. Images of Agastya have been discovered in South India as well as in far off regions like Ceylon, Java, Sumatra etc. Agastya may have been perhaps the first navigator because, according to another legend, he is described as having swallowed all the waters of the ocean.

One more legend describes Agastya as the oarsman who carried the Sun God, at the time of the deluge, in his boat " *Arghā* " (अर्घा).

In ancient Sanskrita literature Agastya is mentioned as rising in the East before the Sun at the end of the rainy season.

Canopus is not visible from places beyond Latitude 40° N., hence there is hardly any importance attached to it in Western literature.

Canopus is estimated to be at a distance of about 300 to 400 light-years away from us. According to the first estimate, it should be 10,000 times brighter than the Sun; but the second estimate makes Canopus at least 40,000 times brighter. Some observers have estimated its distance to be about 650 light-years.

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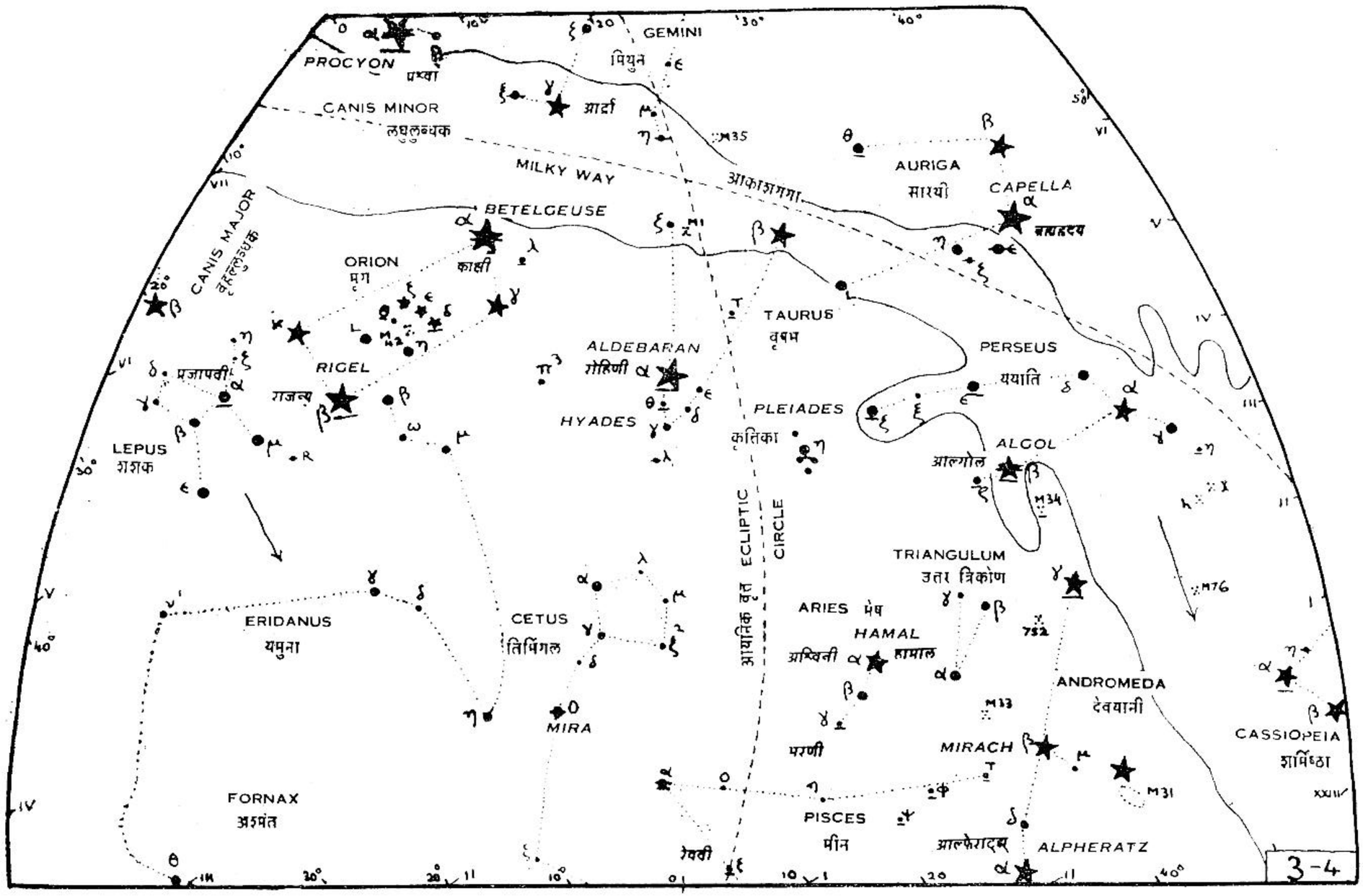


Observer's Latitude 25° N

November	1 at 5 a.m. (I. S. T.)	**MARCH**	November 15 at 4 a.m. (I. S. T.)
December	1 at 3 a.m.	**WEST**	December 15 at 2 a.m.
February	1 at 11 p.m.		February 15 at 10 p.m.
March	**1 at 9 p.m.**	**KEY-MAP**	**March 15 at 8 p.m**
April	1 at 7 p.m.		April 15 at 6 p.m.

MARCH : WESTERN SKY

Prominent Stars :

α and β in Andromeda (Alpheratz, Mirach, Almakh).
α in Aries (Hamal).
α, and o in Cetus (Menka the head, and Mira).
α, β in Orion (Betelgeuse and Rigel).
β in Perseus (Algol).
α in Taurus-Hyades (Aldebaran).

Double Stars :

γ in Andromeda, gold and blue; magnificient object.
γ in Aries, interesting double seen with a 5 cm telescope.
θ_2, δ in Orion, seen with a binocular,
θ, in Orion, can be resolved into 4 stars forming a trapezium seen with a 5 cm telescope.
β in Orion, 202″ apart, seen through a 5 cm. telescope.
β in Perseus, eclipsing binary, known since 300 years ago. One component is dark and one is bright. There are 2 more components, making β a quadruplet.
ε, ζ, η in Perseus, seen with a 5 cm. telescope.
η in Taurus-Pleiades, bright and wide double.
0 in Taurus-Hyades, wide naked eye double.
τ in Taurus-Hyades, field-glass double.

Variable Stars :

o in Cetus, first variable star, discovered, whose brightness changes by a factor of 2100.
α in Orion (Betelgeuse), red bright star, irregularly variable.
β in Perseus, regularly variable, period 2 d, 20 h. 48.9 m. Seen with naked eyes.

Nebulae and Star Clusters :

M 31 (NGC 224) in Andromeda. Contains more than 100 novae, and has an estimated mass equal to 3×10^{10} solar masses.
M 42 (NGC 1976) below σ in Orion; Great Orion Nebula seen with naked eyes.
M 76 (NGC 650) neari ϕ in Perseus, dumb-bell shaped and belonging to our galactic system.
A faint nebula in Taurus near Merope (Star No. 23), not shown here, in Pleiades. Well seen in the finder of a telescope.
M 33 (NGC 598) near α in Triangulum, seen with small telescope. This happens to be one of the nearest galaxies.

* * *

Pyxis

THE NAME and the concept of this constellation are new. Pyxis means the Mariner's Compass and it is a part of the former constellation Argo. (See Fig. 34 on Page 65). Pyxis represents the fore part of the ship. The constellaiton is inconspicuous. There are 9 stars making a four-sided figure, but none of them is brighter than of magnitude 4.

* * *

Vela

THE CONSTELLATION lies in the Milky Way. The nomenclature is new. Vela means the Sails and it is regarded as the upper part of the former constellation Argo. (See Fig. 34 on Page 63)

There are many bright stars. The star γ called Muhalik, is of magnitude 2.1 and it has two companions. One of the companions is found to be very hot and it is claimed to be of the Wolf Rayet type.

Stars δ and λ are of magnitude 2. Star o (Omicron) is to the north of δ and there is a star cluster in its neighbourhood. There are 3 other stars of magnitude 3.

* * *

Observer's Latitude 25° N

MARCH ZENITH NIGHT-SKY

November	1 at 5 a.m. (I. S. T.)	November	15 at 4 a.m. (I. S. T.)
December	1 at 3 a.m.	December	15 at 2 a.m.
February	1 at 11 p.m.	February	15 at 10 p.m.
March	**1 at 9 p.m.**	**March**	**15 at 8 p.m.**
April	1 at 7 p.m.	April	15 at 6 p.m.

Cancer

THIS IS a constellation of the northern hemisphere. In the month of March at about 8 p.m., it can be seen in the eastern sky somewhat halfway between Castor and Pollux, the bright stars of Gemini, and Regulus, the bright star of Leo. Castor and Pollux are almost overhead at this time. One can make out about six stars with the naked eye, but none of them is brighter than magnitude 4. The star δ is situated exactly on the Ecliptic and if we draw from δ four lines in different directions they reach the four stars of Cancer viz. α, β, γ and ζ. Of these α. β are somewhat on the southern side. ζ is on the western side and γ on the northern side. Other small stars are not shown in the map.

There is a bright spot near the line joining δ and γ and almost half-way between them. This bright spot is the famous star cluster M 44, otherwise known as NGC 3632. It is popularly called Praesepe or the Beehive on account of the resemblance to it. This is at a distance of about 500 light-years from us.

There is another star cluster near the star α, and it is called M 67 (NGC 2512). This can be located with field glasses.

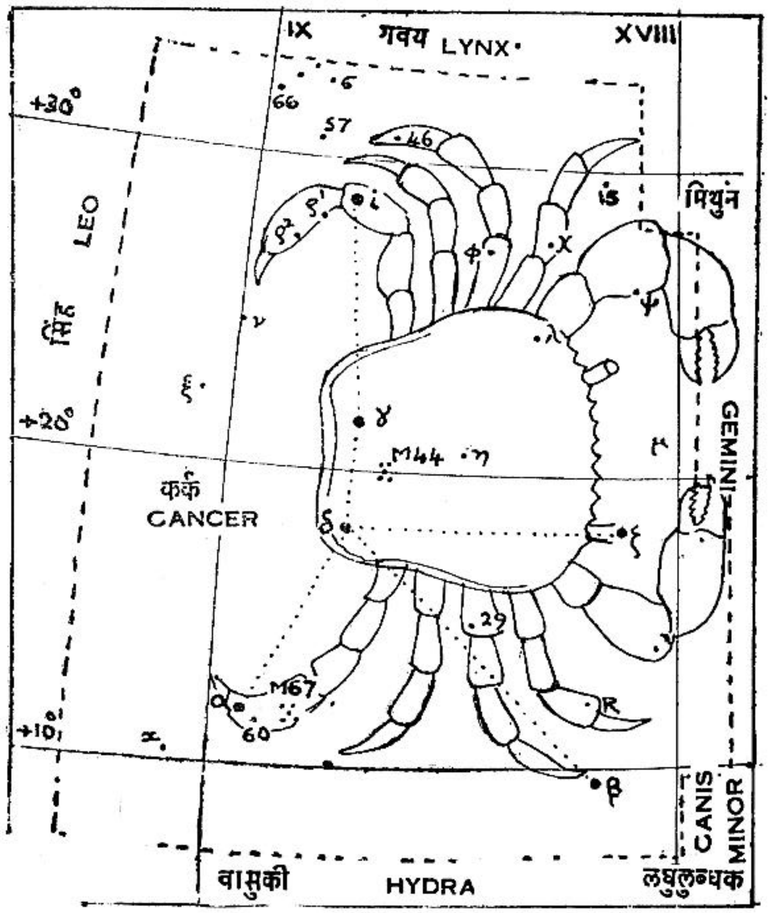
According to Greek mythology, while Hercules was engaged in fighting Hydra, the King of Snakes, he was bitted by a crab under instructions from Juno. Hercules subsequently destroyed both the snake and the crab, but Juno did not like this action of Hercules and therefore rewarded the crab by placing it among the stars as a constellation.

The Chaldeans considered that the dim light of the cluster Praesepe came from a hole in the floor of the heaven and thus believed that the hole could be no other than the " gate of men " through which souls descended to enter into human bodies.

According to Egyptian mythology, Cancer, the crab, is considered to be really a " Bee ". This would account for the name " Beehive".

According to Indian mythology, *Puṣya Nakṣatra* (पुष्य नक्षत्र) is a part of this constellation.

With the discovery of the telescope, it was Galileo who first revealed the structure of the diffuse spot Praesepe by counting 40 small stars in it. Now we know that it contains at least 363 stars.



Big. 3.6 : Cancer (कर्क)

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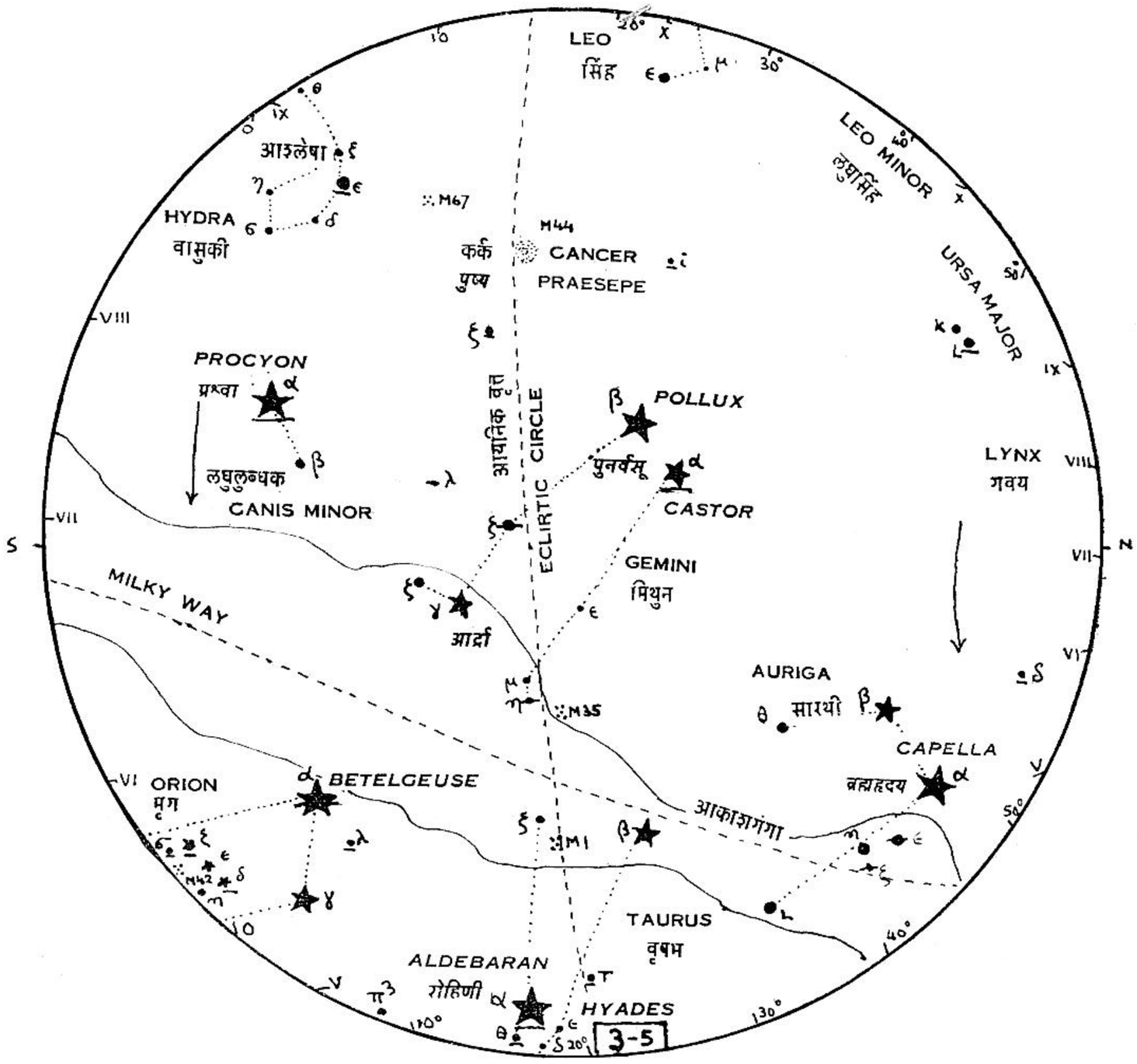


Observer's Latitude 25°N

MARCH ZENITH KEY-MAP

November	1 at	5 a.m.	(I. S. T.)
December	1 at	3 a.m.	
February	1 at	11 p.m.	
March	**1 at**	**9 p.m.**	
April	1 at	7 p.m.	

November	15 at	4 a.m.	(I. S. T.)
December	15 at	2 a.m.	
February	15 at	10 p.m.	
March	**15 at**	**8 p.m.**	
April	15 at	6 p.m.	

Canis Minor

THIS CONSTELLATION is to the east of Orion and to the south of Castor and Pollux, the two bright stars of Gemini. Canis Minor means a Small Dog.

This Small Dog along with the Big Dog, Canis Major *, were supposed to be the dogs of the Hunter Orion, according to a Greek legend.

According to Indian mythology, Canis Minor and Canis Major were the two "hunting dogs" chasing Orion which was believed to be the Antelope, *Mrga* (मृग) and not the hunter.

It is also sometimes mentioned that this Little Dog is one of Diana's hounds that followed her in the hunt.

Egyptians figure this constellation as a Cow instead of as a Dog.

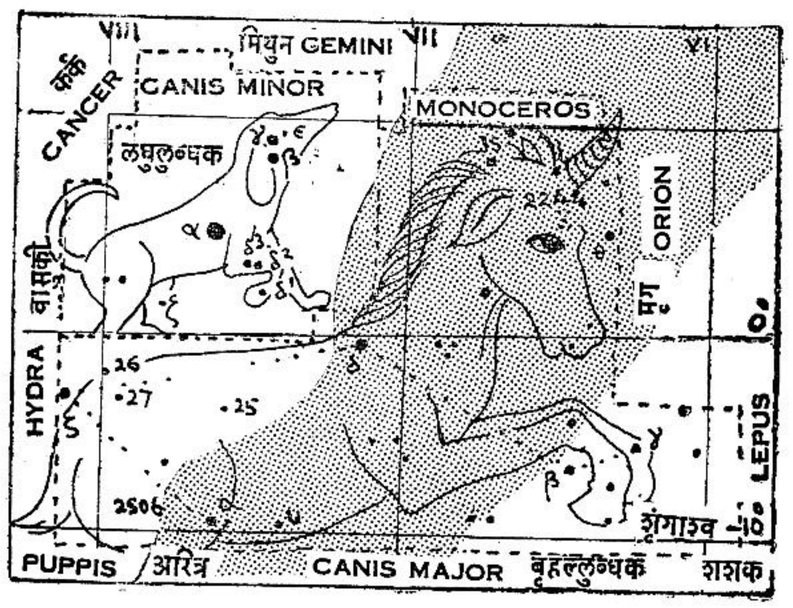


Fig. 3.7 : Canis Minor

* See *Canis Major* on Page 87.

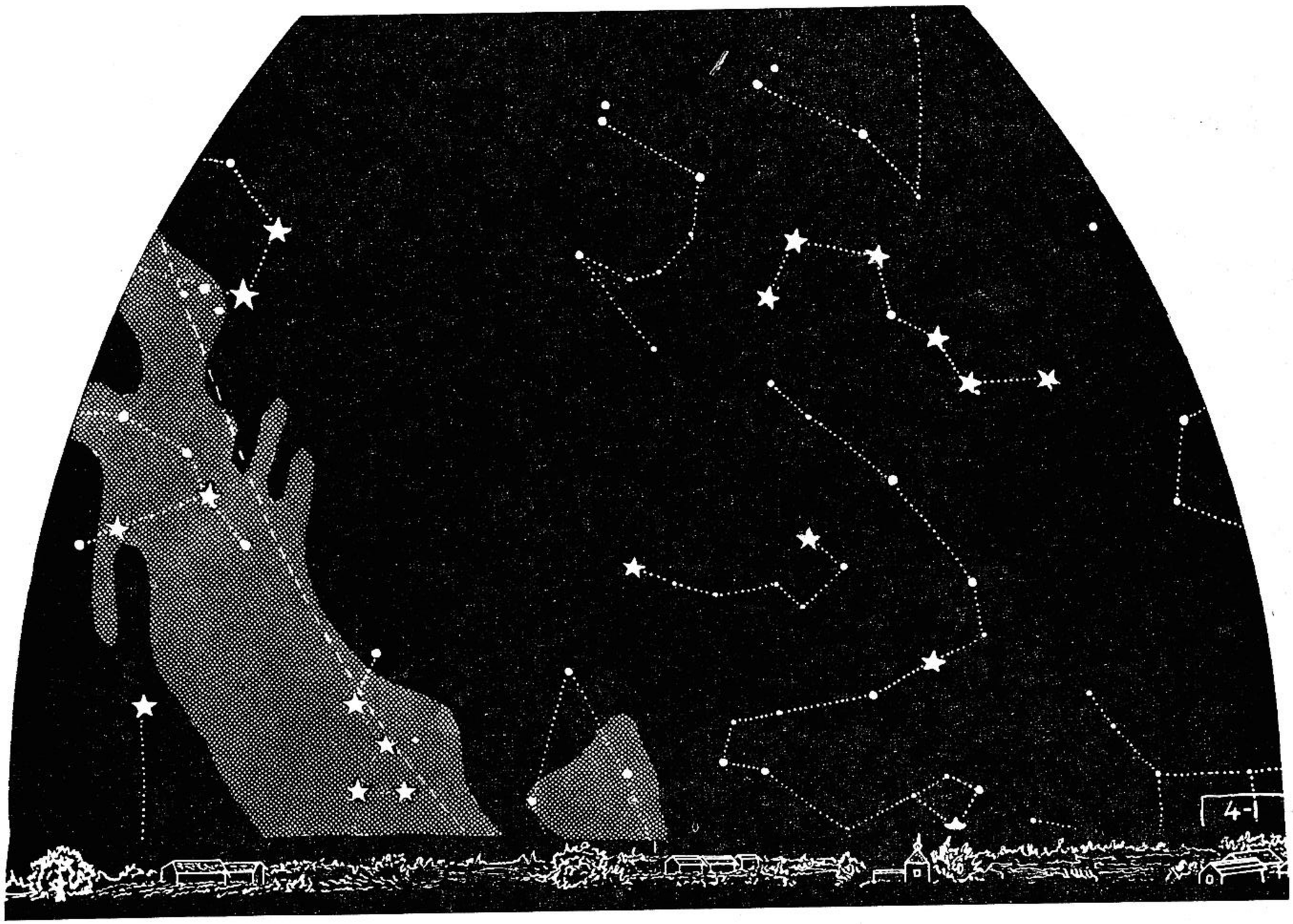
In the period, about 3000 B. C. the bright star of Canis Minor, known as Procyon, used to rise above the horizon along with Sirius, before the actual sunrise. In those days at this time of the year the river Nile used to be in floods.

About 3000 B. C. Procyon appeared above the eastern horizon and shone for about half an hour before the Sun appeared on the scene. Hence the name Procyon. It does not happen now.

The bright star Procyon is of magnitude 0.48. The other less bright star β is called Gomeiza and its magnitude is 3.9.

It is easy to locate this constellation, because Procyon makes up with Betelgeuse of Orion and Sirius of Canis Minor an equilateral triangle. Procyon is yellowish in colour and it is a double star. Its distance from us is about 11 light-years. The companion of Procyon is very faint, of magnitude 13, and it can be seen only through a large telescope. The period of revolution around their common center of gravity is about 40 years. There is a great difference in their luminosities. While the luminosity of Procyon is seven times that of the sun, it is almost 100,000 times that of the companion.

* * *



Observer's Latitude : 25°N

APRIL
NORTH
NIGHT-SKY

December	1	at	5	a.m. (I. S. T.)
January	1	at	3	a.m.
March	1	at	11	a.m.
April	**1**	**at**	**9**	**p.m.**
May	1	at	7	p.m.

December	15	at	4	a.m. (I. S. T.)
January	15	at	2	a.m.
March	15	at	10	p.m.
April	**15**	**at**	**8**	**p.m.**
May	15	at	6	p.m.

Ursa Major

THIS IS a constellation known from ancient times and it has several names given to it according to the object fancied by the observer. Great Bear, Hippopotamus, Seven Sages (*Saptarṣī* सप्तर्षी). Plough, Dipper are some of the more common names. The group is

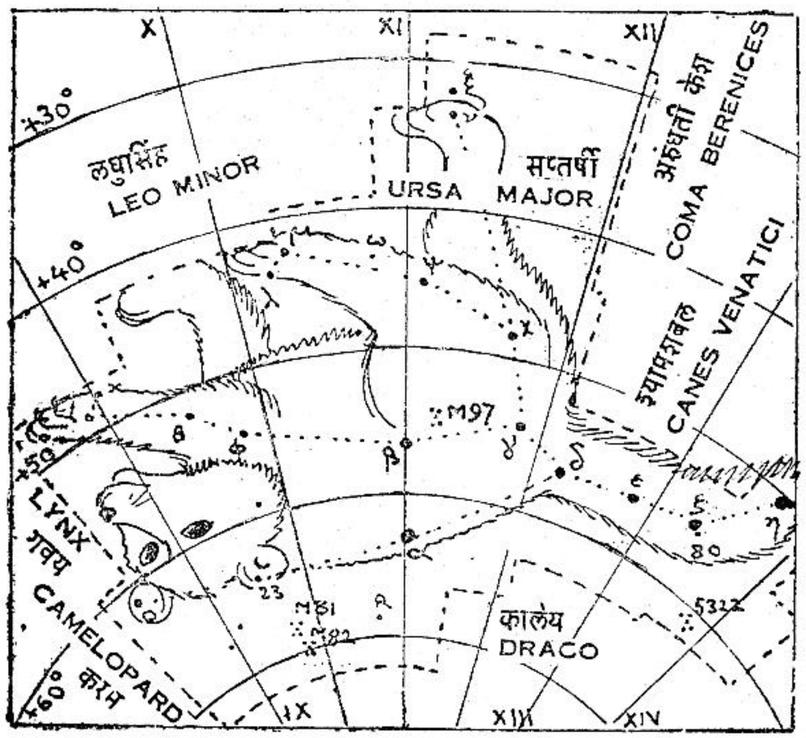


Fig. 4.1 : Ursa Majei (Saptarṣī)

easy to locate. There are 7 bright stars, four of them making a quadrangle and three others making a tail of a kite or a handle of a plough, according to one's imagination. When the constellation is shown as a bear, the rectangle becomes the body, three faint stars make the paws and some other faint stars make the head.

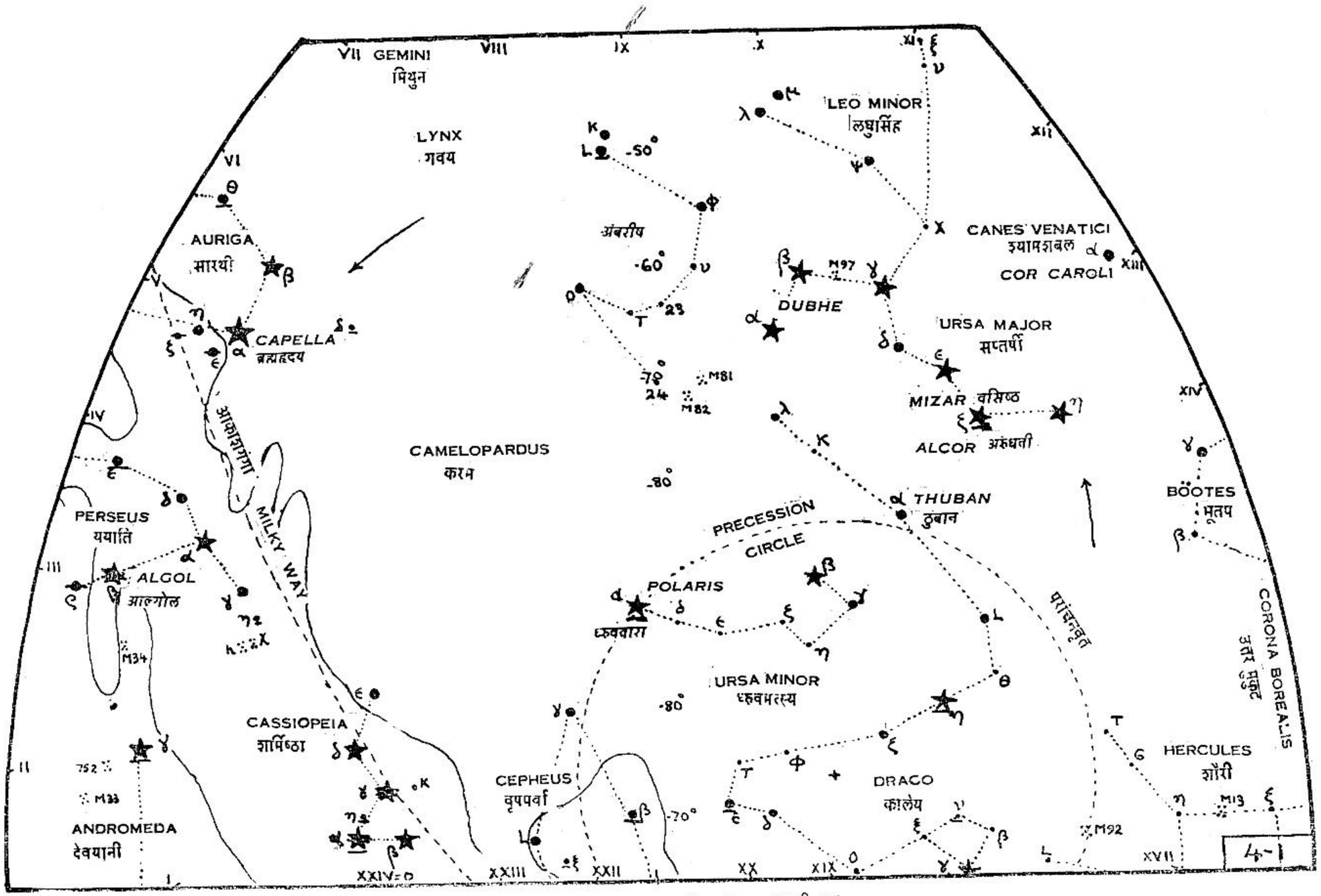
According to Indian Mythology, the name is Seven Sages *Saptarṣī* (सप्तर्षी). This Sanskṛta word, has remarkably, a double meaning. *Saptarṣi* therefore, means either "seven bears" or "seven sages". The pun is on the word *Ṛkṣa* (ऋक्ष) which means either an ancient *ṛṣi* (ऋषि) or a bear. Among the seven sages the star ζ (Mizar) is named after *Vasiṣtha* (वसिष्ठ). The faint star Alcor in its neighbourhood is called *Arundhatī* (अरुंधती). When Hindu marriages are celebrated, it is a tradition that the groom must show to his bride the pair of Stars *Vasiṣtha* and *Arundhatī* and the bride must be able to see them with naked eyes. If anyone fails to do so, it is regarded as a bad omen.

Star ζ, Mizar, itself is actually a double. With Alcor in close proximity it is often described as a triplet, but this is merely a popular description.

The 2 bright stars at one end β and α, are called the Pointers, because the line passing through them leads to the Pole Star. Knowing the Pointers, drawing a line through them and producing the same, about $5\frac{1}{2}$ times the distance between them we come to the Pole Star, which is really α of Ursa Minor.

According to Greek Mythology, Ursa Major was not a bear at all. It was originally a beautiful and unfortunate nymph by name Callisto. She was transformed into a shaggy bear by Juno, the jealous wife of Jupitor. On one occasion, while Callisto was roaming in the mountains, as a bear, her own son Arcas hit her with an arrow, because he was quite ignorant of the fact that the bear was really his own mother. When Jupiter saw this unfortunate incident, he lost his temper, hit the boy and turned him into another small bear and threw him towards the sky. Later on when Jupiter came to realise the actual position, he arranged to have both the bears, the mother and the son, among the constellations. These are now our Great Bear and Small Bear or Ursa Major and Ursa Minor respectively.

(Continued on Page 77 Column 2)



Observer's Latitude : 25° N

APRIL
NORTH
KEY-MAP

December	1 at	5 a.m.	(I. S. T.)
January	1 at	3 a.m.	
March	1 at	11 a.m.	
April	**1 at**	**9 p.m.**	
May	1 at	7 p.m.	

December	15 at	4 a.m.	(I. S. T.)
January	15 at	2 a.m.	
March	15 at	10 p.m.	
April	**15 at**	**8 p.m.**	
May	15 at	6 p.m.	

APRIL : NORTHERN SKY

Prominent Stars :

α in Auriga (Capella).
α, β in Cassiopeia (Shedar and Caph).
α in Draco (Thuban), former Pole Star of 3000 B. C..
β in Perseus (Algol).
α, β in Ursa Major (The Pointers).
ζ in Ursa Major (Mizar) with its neighbour Alcor.
α in Ursa Minor (Polaris), the present Pole Star..

Double Stars :

α in Cassiopeia, lovely double rose and blue
η in Cassiopeia seen with a 5 cm telescope.
β in Perseus (Algol) eclipsing binary, known since 300 years ago. It has 2 more components, making it a quadruplet.
ζ in Ursa Major (Mizar) is itself a double seen with a 5 cm telescope. Alcor is a dillerent Star.
α in Ursa Minor, wide double, 18" apart seen with a 5 cm. telescope.

Variable Stars :

α in Cassiopeia is multiple and variable; changes from 2.2 to 2.8 magnitudes.
β in Perseus, regularly variable of period 2 d. 29 hrs. 48.9 mins.

Nebulae and Star Clusters :

M 76 (NGC650) in Perseus near φ. Dumb-bell shaped. This belongs to our Galaxy, the Milky Way.
h (NGC 869) and χ (NGC 884) in Perseus, bright and diffuse spots seen with naked eyes.
M 97 (NGC 3587) in Ursa Major known as the Owl Nebula. Large aperture and low power are required for a good view on a clear night.
M 81 (NGC 3031) and M 82 (NGC 3034) in Ursa Major, both are included in sight with a very low power.

* * *

URSA MAJOR

(Continued from Page 75 Column 2)

The star names correspond to the organs of the Bear. Below are given the names of the stars, with their Arabic meanings and also the corresponding names of the sages in Indian mythology.

α	= Dubhe	= Bear	= (क्रतु)	*KRATU*
β	= Merak	= Hip	= (पुलह)	*PULAHA*
γ	= Phecda	= Thigh	= (पुलस्य)	*PULASYA*
δ	= Megrez	= Beginning of the tail	= (अत्रि)	*ATRI*
ε	= Alioth	= Tail	(अंगिरा)	*AṄGIRĀ*
ζ	= Mizar	= Waist	= (वसिष्ठ)	*VASIṢTHA*
80	= Alcor	= Neglected	= (अरुंधती)	*ARUNDHATĪ*
η	= Alkaid	= End of the tail	= (मरीची)	*MARĪCĪ*

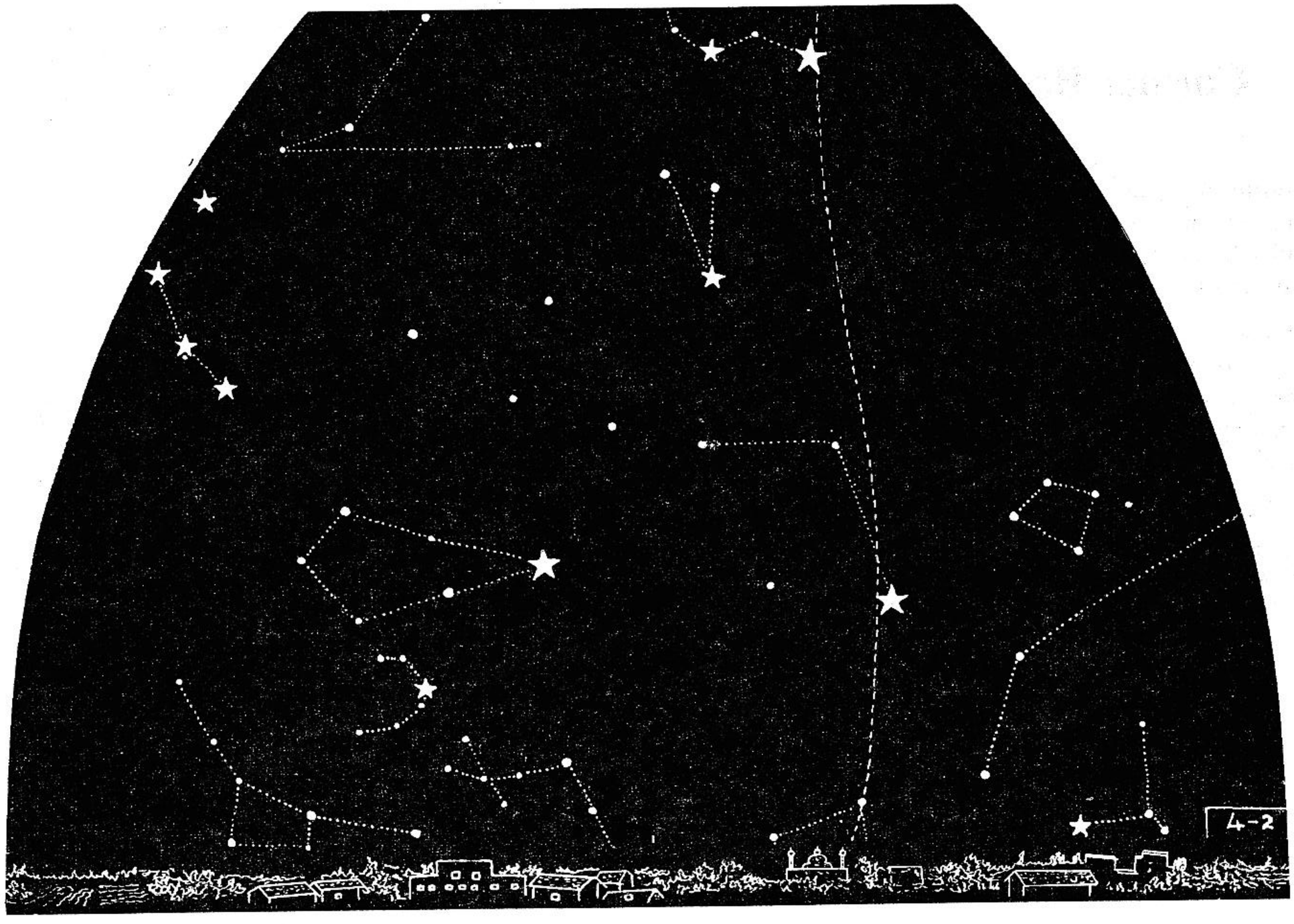
There are, in the quadrangle of the four bright stars of this constellation, more than 300 Nebulae crowded up in a very small area.

One interesting feature about the stars in Ursa Major is that all of them do not have the same proper motion. Omitting α and, η the other four stars have a common velocity. They go together but the others do not, with the result that after a sufficiently long time the Ursa Major will cease to look like any one of the articles that now describe its shape. The stars in Ursa Major, which have a common velocity, belong to the same group of which Sirius, α of Canis Major. β of Auriga and α of Coma Berenices are members.

Star ω is a variable binary, where the components are ellipsoidal in shape and very close together. The variation in their magnitude has a range of 0.65 and average period of 0.5 day, varying between 0.2 and 1.2 days. Both the companions are White Dwarfs.

* See fig 4.3 at Page 81.

* * *



Observer's Latitude : 25° N

APRIL
EAST
NIGHT-SKY

December	1 at	5 a.m.	(I. S. T.)
January	1 at	3 a.m.	
March	1 at	11 am.	
April	**1 at**	**9 p.m.**	
May	1 at	7 p.m.	

December	15 at	4 a.m.	(I. S. T.)
January	15 at	2 a.m.	
March	15 at	10 p.m.	
April	**15 at**	**8 p.m.**	
May	15 at	6 p.m.	

Corona Borealis

IT IS a small constellation of the northern sky, situated between Hercules and Bootes.The name means the Northern Crown, and it is quite meaningful. Seven stars make up a semicircular are with the brightest star in the centre.

One ancient legend considers that the constellation looked like a broken plate held by a beggar to receive alms. Another legend describes the semi-circular arrangement of the stars as a War Council, meeting around a camp-fire. The Australians likened this constellation to their famous weapon and toy "Boomerang".

According to Greek mythology, Theseus was the King of Athens and Ariadne was his queen. On one occasion, when Theseus was returning home after his adventure with the monster Minotaur, the Goddess Minerva advised him not to go back to Athens in the company of the Queen Ariadne. Curiously enough Theseus agreed to desert the queen on a lonely island. He had to pay for this heartless behaviour, because later on, he threw himself into the sea and suffered death. In the meantime, Bacchus, the God of Vineyards, came along, discovered Queen Ariadne in a lonely condition and weeping with sorrow. Bacchus was so charmed with the beauty of the deserted queen that he married her and promised to give her a place among the Gods after her death. Queen Ariadne's suspended crown of jewels, Corona, is seen among the constellations in the northern sky.

To the north of Corona, there is a 10th magnitude star which had flared up into a brilliant Nova of 2nd magnitude in the year 1866 A. D. In a few weeks' time, the Nova fell to magnitude 4 and then to 9. After a lapse of 80 years the star rose to magnitude 3 on February 8, 1946. Afterwards it faded rapidly again.

The bright star α is called Gemma or Al phecca, and its neighbour β is called Nukasen.

The bright star α (Gemma or Al phecca) and its neighbour β (Nusaken) are strangely enough travelling in opposite directions. It is feared, therefore, that in course of time the Celestial Crown would be broken up. * Gemma means a jewel and the star is a wellknown double for a 2" telescope. Star β is a double with a period of about 11 years.

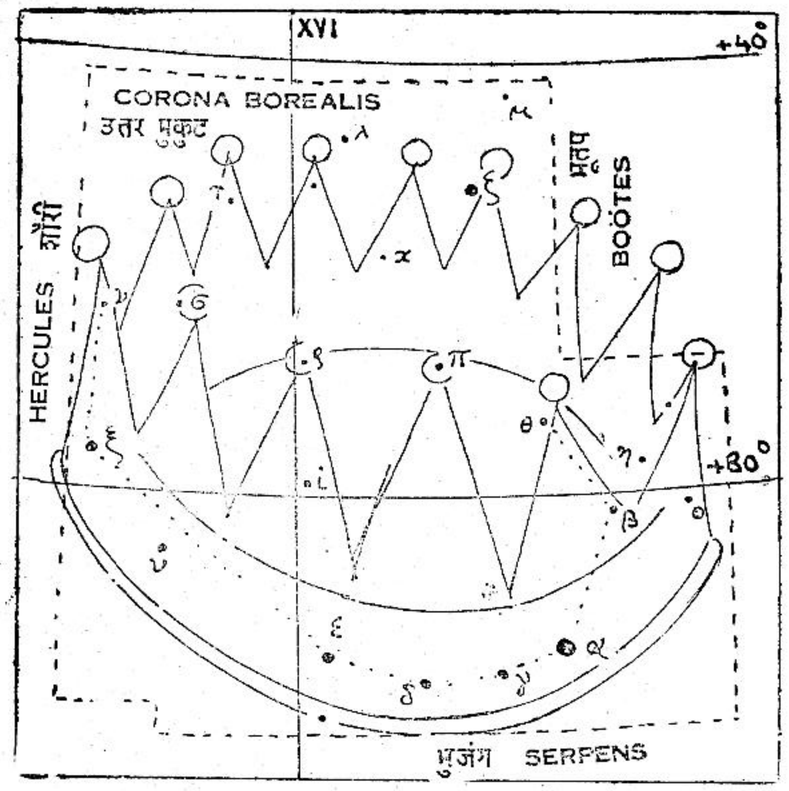
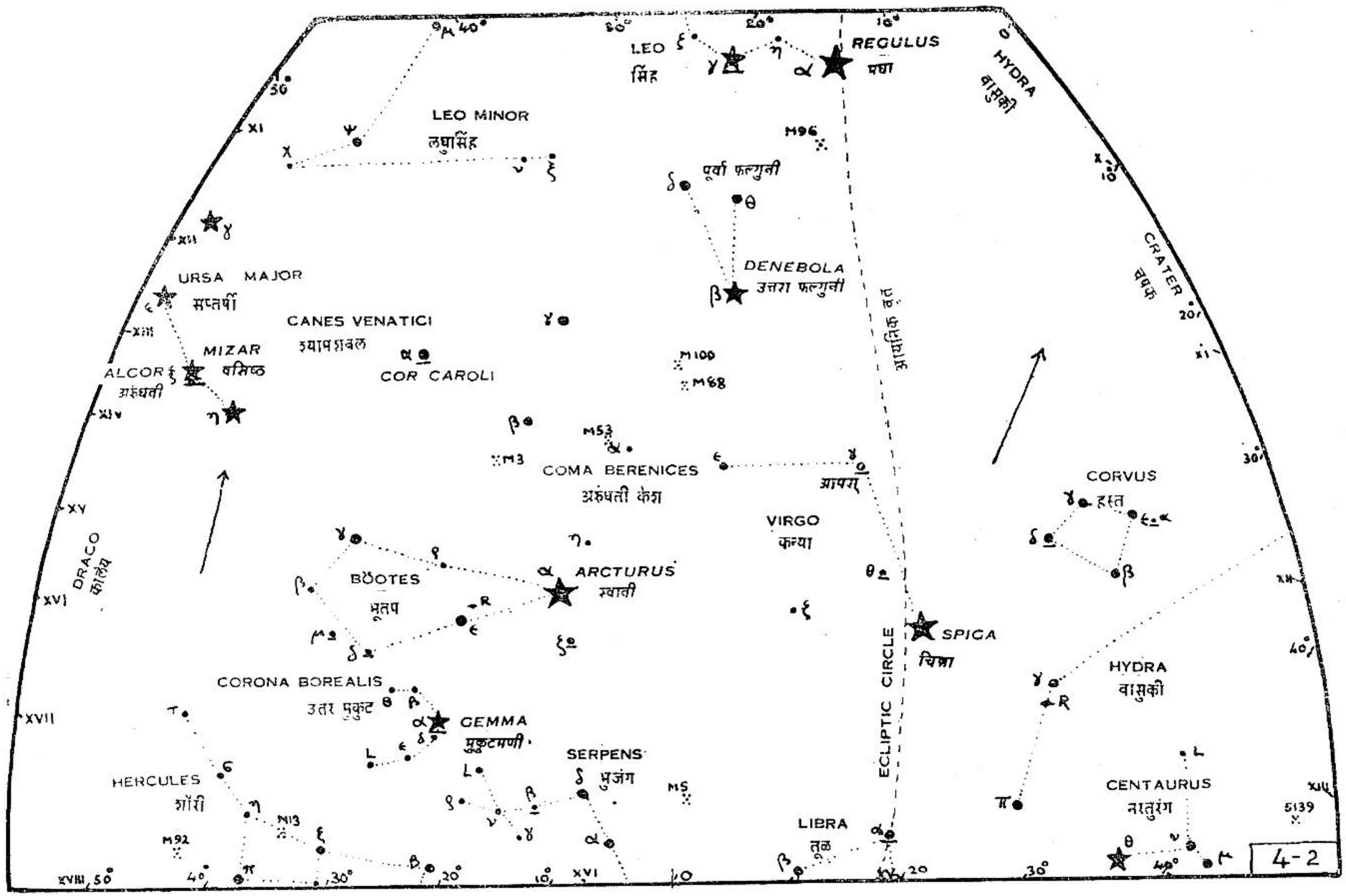


Fig. 4.2 : Corona Borealis

* See : Proper Motions of Stars at Page 191

* * *



Observer's Latitude : 25° N

APRIL
EAST
NIGHT-SKY

December	1 at 5 a. m. (I. S. T.)
January	1 at 3 a. m.
March	1 at 11 a. m.
April	**1 at 9 p. m.**
May	1 at 7 p. m.

December	15 at 4 a. m. (I. S. T.)
January	15 at 2 a. m.
March	1 at 10 p. m.
April	**15 at 8 p. m.**
May	15 at 6 p. m.

APRIL : EASTERN SKY

Prominent Stars :

- α in Bootes (Arcturus).
- α in Canes Venatici (Cor Caroli).
- α in Coma Berenices.
- α in Corona Borealis (Gemma).
- α in Leo (Regulus) on the Ecliptic.
- β in Leo (Denebola).
- α in Virgo (Spica) on the Ecliptic.

Double Stars :

- γ in Leo, orbital period of 619 years, seen with a 5 cm telescope,
- α in Canes Venatici, seen with a 5 cm. telescope.
- δ, μ in Bootes, companions are fainter than the main stars. Companions have magnitudes about 2 to 4 less. Seen with field glasses.
- γ in Virgo, equally bright components, seen with a 5 cm telescope.

Nebulae and Star Clusters :

M 3 (NGC 5272) in Canes Venatici under star 25, open brilliant cluster, under favourable conditions seen with naked eyes,

M 53 (NGC 5024) in Coma Berenices above star 42, globular cluster, seen with field glasses.

M 100 (NGC 4321) in Coma Berenices, south of star 11, seen with field glasses.

M 96 (NGC 3368) in Leo between α and β, Spiral nebula seen with field glasses.

* * *

Changing Shape of Ursa Major

ALL THE stars that are seen in the sky are neither stationary nor moving in space with the same speed. In Ursa Major, the five stars β, γ, δ ε and ζ possess a common proper motion. The stars α and η, however, move in nearly opposite direction. This causes a change in the overall shape of the entire constellation.

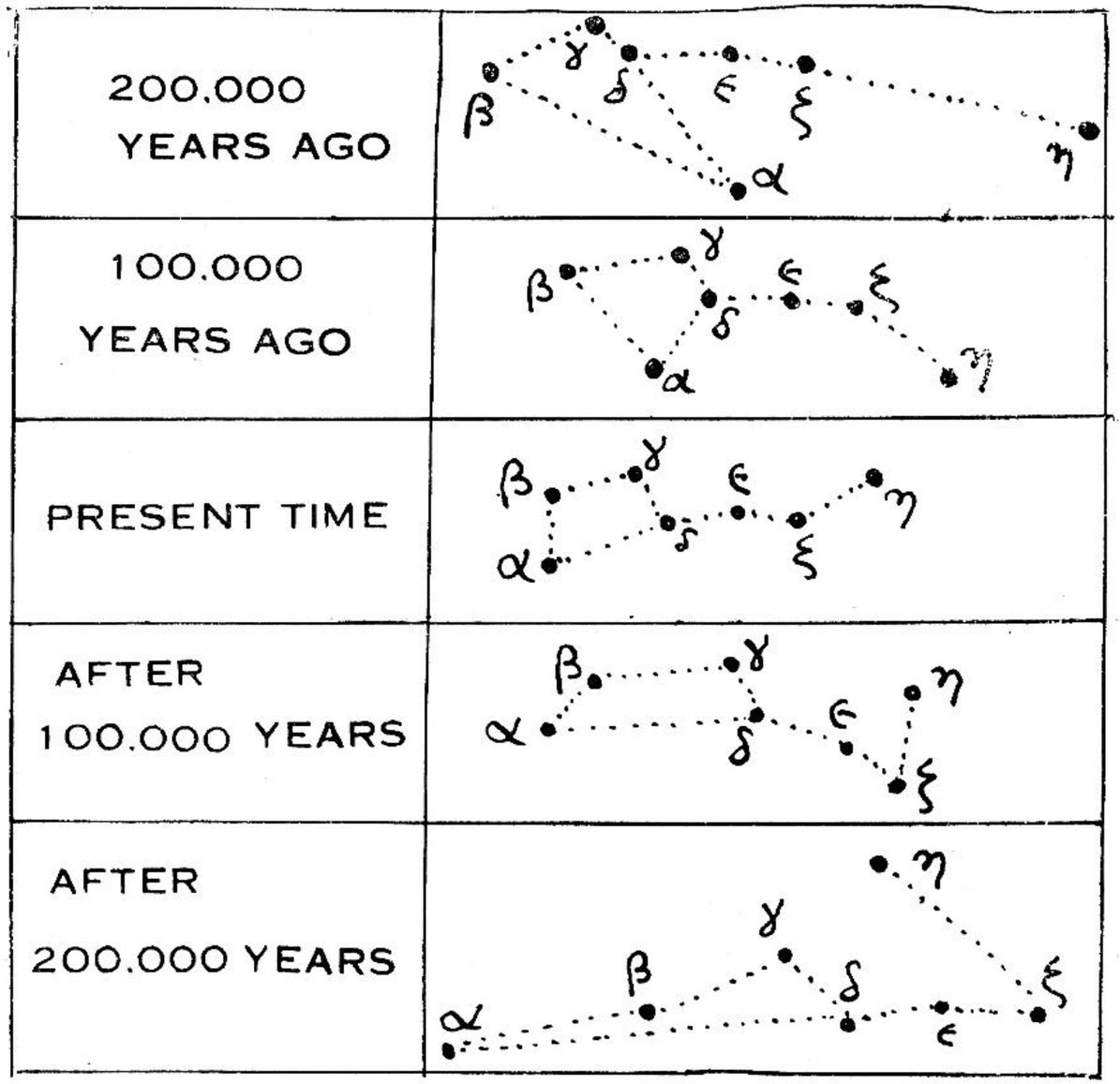


Fig. 4.3 : Changes in of the figure of Ursa Major dnring 4,000,000 years.

* * *

Observer's Latitude : 25° N

APRIL
SOUTH
NIGHT-SKY

December	1 at 5 a. m. (I.S.T.)	December	15 at 4 a. m. (I.S.T.)
January	1 at 3 a. m.	January	15 at 2 a. m.
March	1 at 11 p. m.	March	15 at 10 p. m.
April	**1 at 9 p. m.**	**April**	**15 at 8 p. m.**
May	1 at 7 p. m.	May	15 at 6 p. m.

Corvus

CORVUS, THE Crow, is a constellation of the northern sky and it is situated below Virgo and between Spica and the Crater. Its expanse is small, but it contains 5 or 6 bright stars.

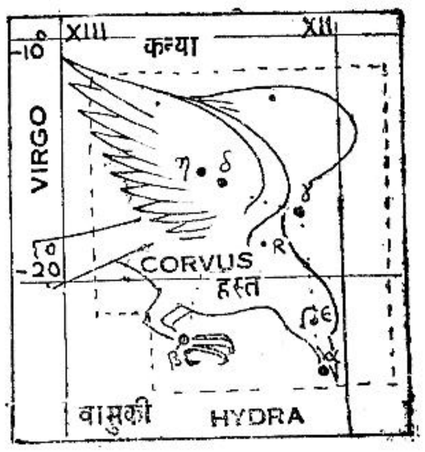


Fig. 4.4 Corvus (Hasta)

There is an ancient legend* which combine the Crow (Corvus) the Cup (Crater) and the Snake (Hydra) in one tale. The Crow was, originally white and a great favourite of the Sun God Apollo. But one day the bird did not behave properly and the God was displeased. In anger, the Sun God changed the colour of the bird from white to black and ordered it not to fly among other birds. This bird, on one occasion, was ordered to fetch water for a sacrifice to Jupiter. The bird did not do as he was ordered and came back with a water-snake in its claws. He also told several foolish lies. The crow was, thereafter, fixed in the sky along with the Cup (Crater) and the Snake (Hydra). The Snake was to prevent the Crow from drinking water in the Cup.

Some other legend mentions that Corvus is actually the Crow that came back with Noah, in his Ark, after the deluge.

* See : Hydra on Page 107; Crater on Page 91

The Egyptians consider that Corvus represents the Crow that was nourished by the King of Snakes " Tiyamut ".

In Indian mythology, Corvus is the right palm of the God Prajāpatī (प्रजापति), of which star β is the thumb *Anguṣṭha* (अंगुष्ठ). and star γ ii the middle finger *Madhyama* (मध्यमा). Star ν is a double, whose main component is yellow. The double can be seen with a small telescope.

The Arabic name of the Stars α and β are Al chiba and Al gerab respectively.

* * *

Musca

THIS IS an inconspicuous constellation of the southern hemisphere meaning the Fly and it is situated on the southern side of Crux. It contains 2 stars of magnitude 3.

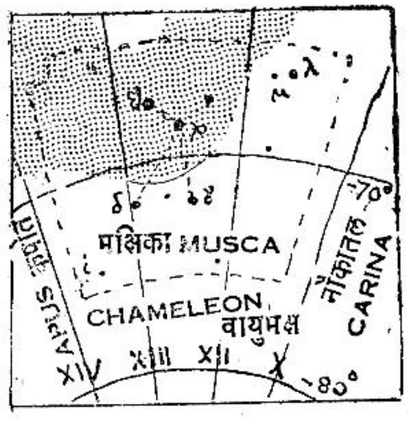
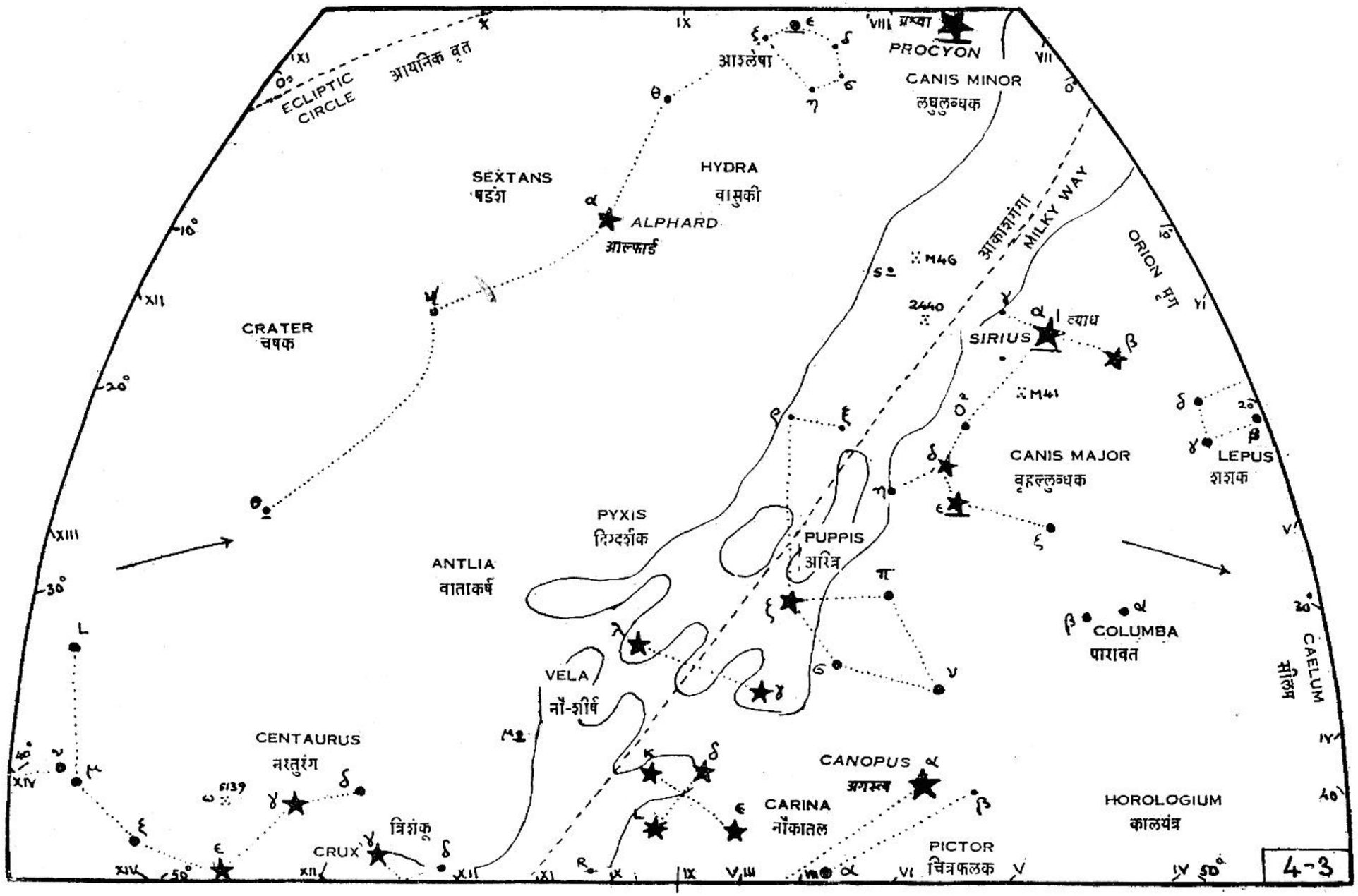


Fig. 4.5 Musca

* * *



Observer's Latitude : 25° N

APRIL
SOUTH
KEY-MAP

December	1 at 5 a. m. (I.S.T.)	December	15 at 4 a. m. (I.S.T.)
January	1 at 3 a. m.	January	15 at 2 a. m.
March	1 at 11 p. m.	March	15 at 10 p. m.
April	**1 at 9 p. m.**	**April**	**15 at 8 p. m.**
May	1 at 7 p. m.	May	15 at 6 p. m.

APRIL : SOUTHERN SKY

Prominent Stars :

- α in Canis Major (Sirius)
- α in Canis Minor (Procyon)
- α in Carina (Canopus)
- γ in Crux, very near the horizon, slightly to the east
- α in Hydra (Alphard)

Double Stars :

- α in Canis Major, companion is 10 magnitudes fainter, a white dwarf.
- α in Canis Minor, companion is 10 magnitudes fainter, a whitedwarf.
- α in Crux (triplet). Companions equally bright, seen in 2.5 cm telescope.
- 0 in Hydra, companion with a difference of 5 magnitudes seen with a 7.5 cm telescope.
- μ in Vela, magnitudes 3.0 and 6.8, fine colour contrast in the companions.

Variable Stars :

- / in Carina, at the lower end of the cross arm of " Pseudo Cross ". Cephaid type with a period of 35.5 days.

Nebula and Star Clusters :

M 41 (NGC 2287) in Canis Major, about 5° below Sirius just visible to the naked eye.

NGC 4755 in Crux, surrounding star K.
Star K is near β and it is a fine red star. A brilliant cluster of over 100 coloured stars, " like a superb piece of jewellery ".

M 46 (NGC 2437) and NGC 2440 in Puppis two beautiful clusters, almost on the same latitude as Sirius, seen with a field glass.

* * *

Birth, Growth and Death of the Sun

SINCE ITS birth, the Sun has been growing still in size. The time interval between two neighbouring pictures of the Sun is about 80 million years. The present age of the Sun works out approximately at 5,000 million years. In about 50,000 million years the size and temperature of the Sun would grow enormously. Afterwards, the Sun will begin to cool down and it will become a white dwarf. In the end the Sun will go on wandering in space as a cool object.

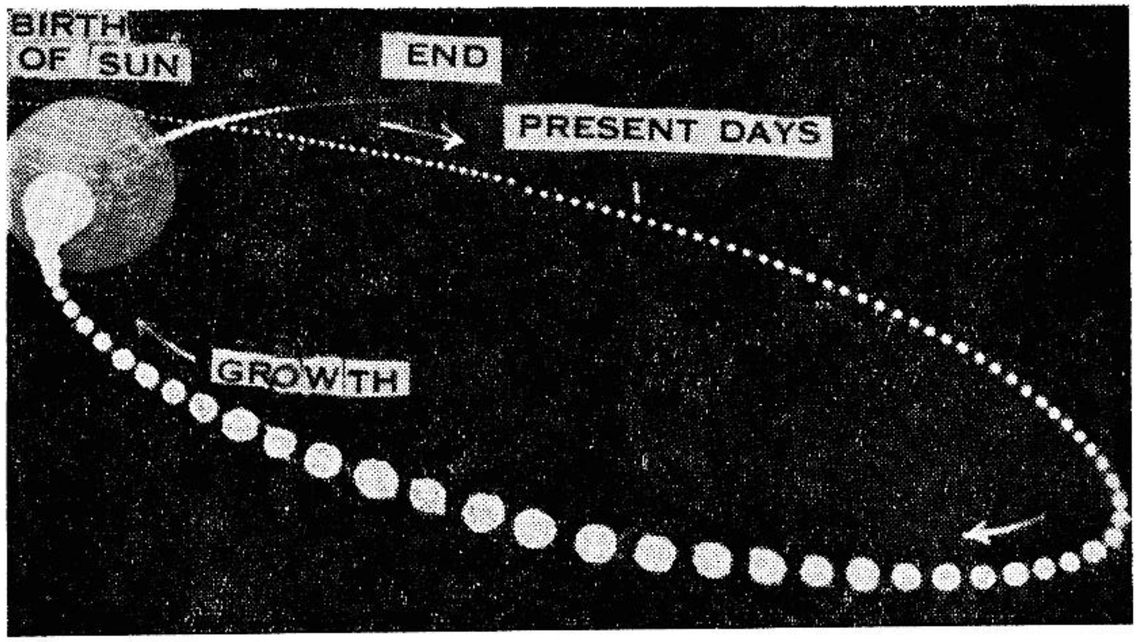


Fig. 4.6 Birth, Growth and Death of the Sun

* * *

Observer's Latitude : 25° N

APRIL
WEST
NIGHT-SKY

December	1 at 5 a. m. (I.S.T.)	December	15 at 4 a. m. (I.S.T.)
January	1 at 3 a. m.	January	15 at 2 a. m.
March	1 at 11 p. m.	March	15 at 10 p. m.
April	**1 at 9 p. m.**	**April**	**15 at 8 p. m.**
May	1 at 7 p. m.	May	15 at 6 p. m.

Canis Major

FACING SOUTH and looking at the sky, in the evening of April, the Milky Way appears on the left (eastern) hand-side to stretch from below upwards. On either side of the Milky Way, slightly one below the other, two bright stars are seen. They are almost one above the other. The star high above the horizon is called Procyon (α of Canis Minor). The other bright star, below the Milky Way about one third the distance from α of Canis Minor and two-thirds the distance from the horizon, is called Sirius (α of Canis Major).

Canis Major and Canis Minor mean Big Dog and Small Dog. In Greek Mythology, they are supposed to be the two dogs of the Hunter Orion.* But Indian Mythology makes out a different story. These two hunting dogs are poised to pounce on their prey, the Orion, which is regarded as an antelope, *Mṛga* (मृग).

The constellation Orion can be seen almost due west and well above the horizon at 8 p. m. on the 15th of April. In ancient times, about the year 3000 B. C., Sirius used to rise just before the sun and the Egyptians used to regard this occurrence as a warning that the river Nile would soon be in floods. Owing to the precession of the equinoxes, the seasons have now changed.†

Sirius can be called the brightest star in the sky, and as such it was very closely observed by astronomers of old. The great mathematician Bessel noticed for over 10 years certain wavy irregularities in its proper motion, and the irregularities led him to conclude that the observed wavy motion was actually the consequence of the revolution of Sirius about the common center of gravity of itself and its partner.

This newly suspected partner, a star of 8th magnitude, was actually discovered after a lapse of 18 years exactly as predicted by Bessel. In 1894 A. D. the two stars were very close to each other and thus the faint star had remained quite invisible. After 31 years, however, the angular

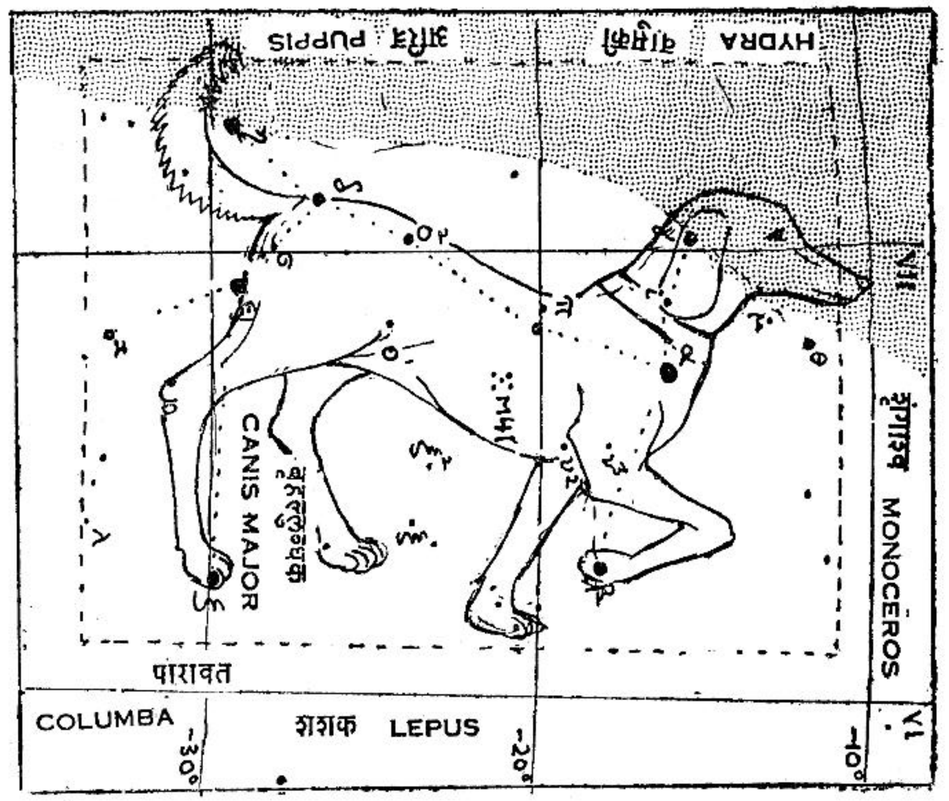


Fig. 4.7 : Canis Major

distance between them was the greatest, about 11″.5. At present they are again very close together and practically invisible except through a very powerful telescope

Sirius is one of our nearest stars being about 8.75 light-years away. It is exceptionally bright, being of magnitude −1.6. If we were to look at our Sun from Sirius, the Sun would appear as a faint star of magnitude 6, and would be just visible.

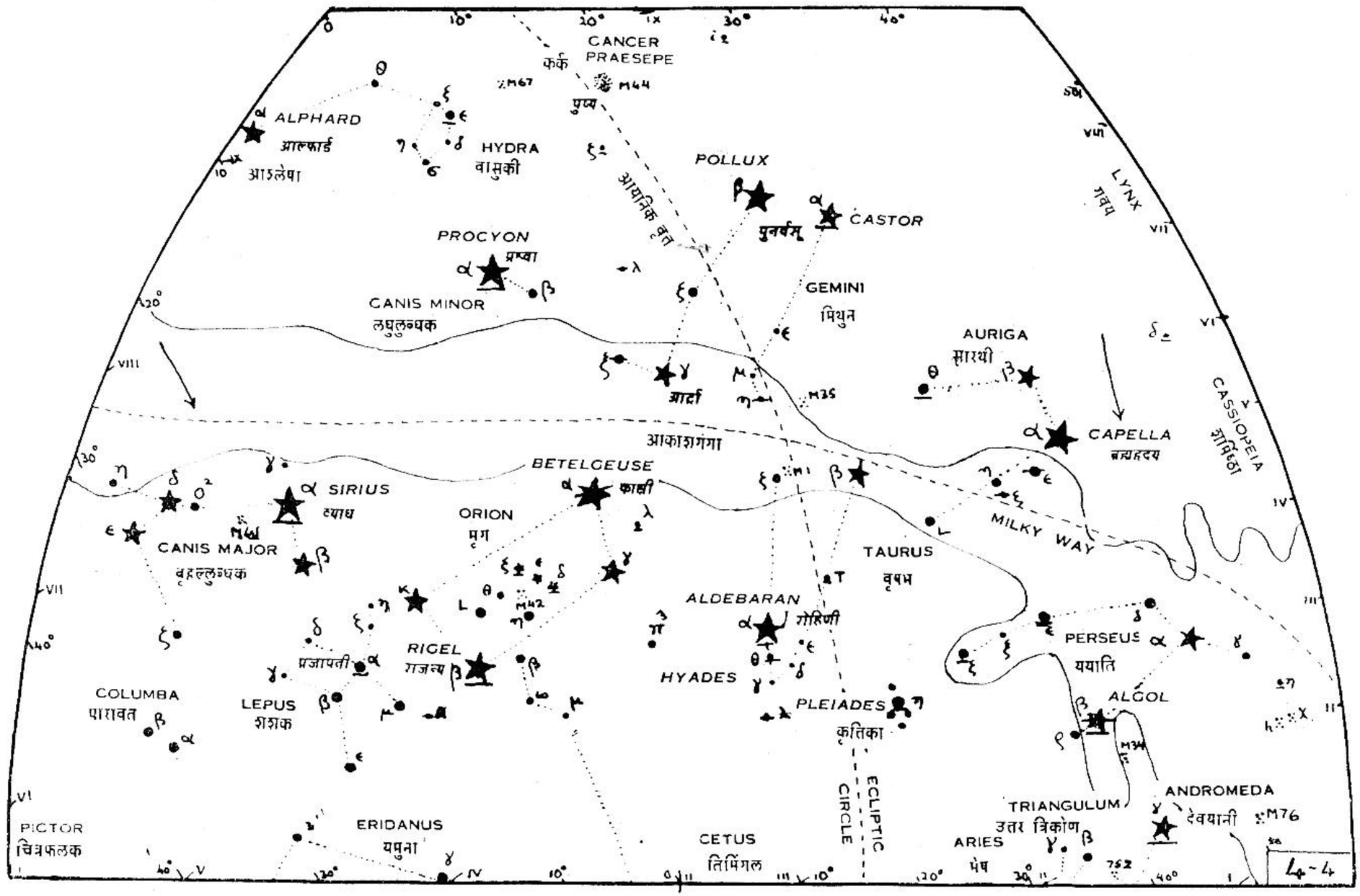
The diameter and the mass of Sirius are 1.8 times and 2.4 times the diameter and the mass of the Sun respectively. Thus the density of Sirius becomes approximately. 0.4 (taking the density of water as 1).

The diameter and the mass of the companion of Sirius are 0.03 times and 0.85 times the diameter and mass of the Sun respectively, so that its density becomes 4×10^4 or nearly 80,000 times that of the main star. Such a star (Sirius B) is, therefore, described as a White Dwarf.

(Continued on Page 89 Column 2)

* See Orion at Page 47

† See Precession at Page 51.



Observer's Latitude : 25° N

December	1 at 5 a. m. (I.S.T.)			December	15 at 4 a. m. (I.S.T.)
January	1 at 3 a. m.			January	15 at 2 a. m.
March	1 at 11 p. m.	**APRIL**		March	15 at 10 p. m.
April	**1 at 9 p. m.**	**WEST**		**April**	**15 at 8 p. m.**
May	1 at 7 p. m.	**KEY-MAP**		May	15 at 6 p. m.

APRIL : WESTERN SKY

Prominent Stars :

- α in Auriga (Capella).
- α in Canis Minor (Procyon).
- α in Canis Major (Sirius).
- α, β in Gemini (Castor and Pollux).
- β in Perseus (Algol).
- α, β in Orion (Betelgeuse and Rigel).
- α in Taurus—Hyades (Aldebaran).
- η in Taurus—Pleiades (Alcyon).

Double Stars :

- α in Canis Major. Its companion is 10 magnitudes fainter and White Dwarf, seen only with a powerful telescope.
- α in Canis Minor. Its companion is 10 magnitudes fainter and White Dwarf, seen only with a powerful telescope.
- α in Gemini, is a sextuple. 2 main components have an orbital period of 380 years, seen with a 5 cm. telescope. Each of these is a spectroscopic binary and there is a star, circling all, itself a binary.
- λ in Gemini, seen with a 7.5 cm. telescope.
- δ in Gemini, seen with a 5 cm. telescope.
- θ_1 in Orion, can be resolved into 4 stars making a trapezium, seen with a 5 cm. telescope.
- θ_2 δ in Orion, seen with binoculars.
- β in Perseus, a quadruple.
- ε, ζ, η in Perseus, seen with a 5 cm. telescope.
- θ in Taurus-Hyades, seen with naked eyes.
- τ in Taurus-Hyades, seen with a field glass.

Variable Stars :

- ζ and η in Gemini, with periods of 10.2 days and 231 days respectively.
- β in Perseus (Algol), with period 2 d. 20 h. 48.9 min.

Nebulae and Star Clusters :

- M 41 (NGC 2287) in Canis Major, about 5° below Sirius, just visible to the naked eye.
- M 35 (NGC 2168) in Gemini above μ and η, seen with naked eyes.
- *h* (NGC 869) and χ (NGC 884) in Perseus, beautiful bright diffuse spots. Seen with naked eyes.
- M 76 in Perseus near ϕ, Dumb-bell shaped, belonging to our galactic system.
- M 42 (NGC 1976) in Orion below σ in the belt. Great Orion Nebula seen with naked eye.

* * *

CANIS MAJOR

(Continued from Page 87 Column 2)

To the west of Sirius, in the constellation Canis Major, is the Star β called Mirzam. An Egyptian astronomer by name Al Sufi had observed it, in the 10th century, when it was described as a star of 3rd magnitude. But this star remained invisible at the end of the 17th century. At the present time it is a star of 2nd magnitude and quite bright.

Of the three other stars in Canis Major, ε (Adhera) is of magnitude 1.5. δ (Wezen) is of magnitude 2.0 and η (Aledra) is of magnitude 2.4. They form a triangle, below Sirius. It is said that the solar system commenced its journey from the neighbourhood of star η and it is now proceeding towards Vega (α in Lyra) with a speed of about 20 Km. per second.

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Observer's Latitude : 25° N

APRIL
ZENITH
NIGHT – SKY

December	1 at 5 a. m. (I. S. T.)	December	15 at 4 a. m. (I. S . T.)
January	1 at 3 a. m.	January	15 at 2 a. m.
March	1 at 11 p. m.	March	15 at 10 p. m.
April	**1 at 9 p. m.**	**April**	**15 at 8 p. m.**
May	1 at 7 p. m.	May	15 at 6 p. m.

Antlia

THE NAME of the constellation means the Pump, and the nomenclature is modern. The constellation consists of a group of stars to the south of Hydra and to the south-east of Argo. There is no star brighter than of magnitude 5.

* * *

Chameleon

THE CONSTELLATION appears like the animal Chameleon. The constellation lies in the southern hemisphere somewhat near the south pole. It contains seven stars of about 5th magnitude and it is often called "the Great Bear of the Southern Sky". Chinese call it "Siu Tau" meaning "a saucepan with a handle".

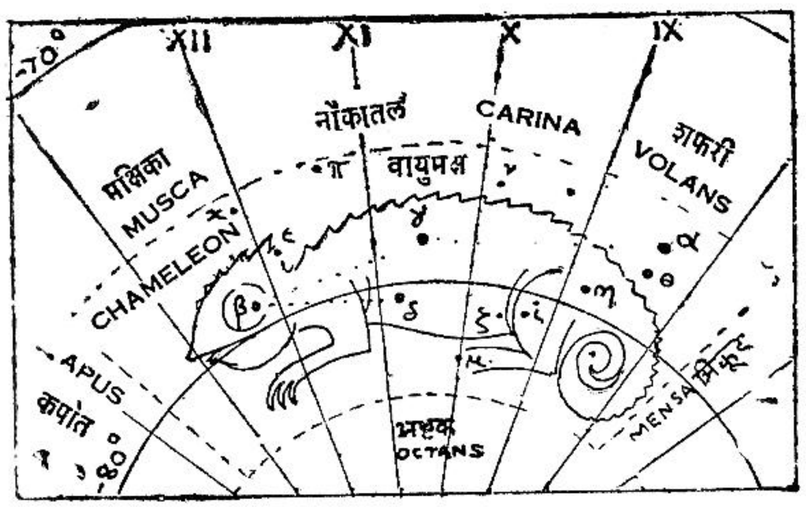

Fig. 4.9 Chameleon

* * *

Circinus

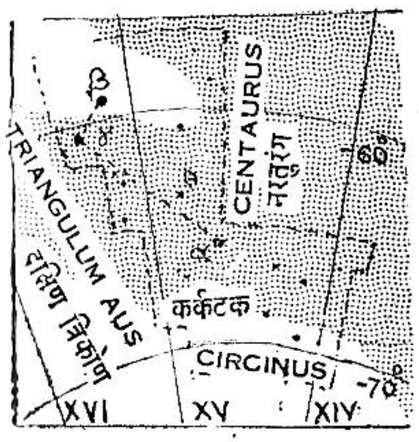

Fig. 4.9 Circinus

THE NAME of the constellation means the Compass. It is near the bright star α of Centaurus and therefore easy to locate. The nomenclature is modern. There are 3 stars, each of magnitude 3, 4 and 5 respectively.

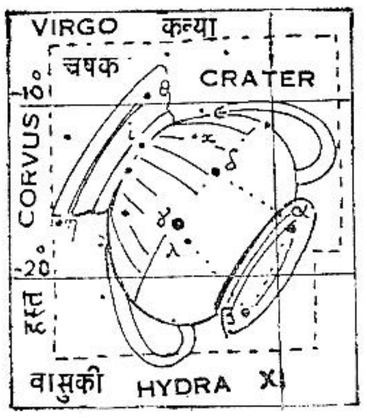

Fig. 4.10 Crater

Crater

THE NAME of the constellation means the Cup. It is inconspicuous and lies in the south between Hydra and Virgo. Four of its faint stars form an irregular quandrangle, giving it the shape of a cup or a bowl. The star α is called Alkes in Arabic.

* * *

Lepus

THIS CONSTELLATION meaning "the Hare" is to the south of Orion. It is made up of 4 stars and has the shape of a long rhombus. The star δ, situated in the eastern corner of the rhombus is receding from us with a velocity of nearly 98 Km. per second. According to mythology, some believe that this hare was formerly located on the moon. Others consider that this is the same hare that was hunted by Orion. According to Egyptian lore, it is considered that this figure represents the sailing vessel of Osiris. There is a star cluster on the Southern side of Lepus.

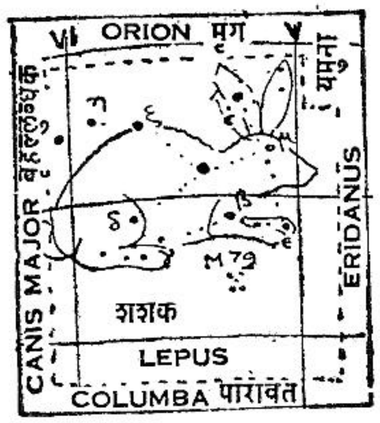

Fig. 4.11 Lepus

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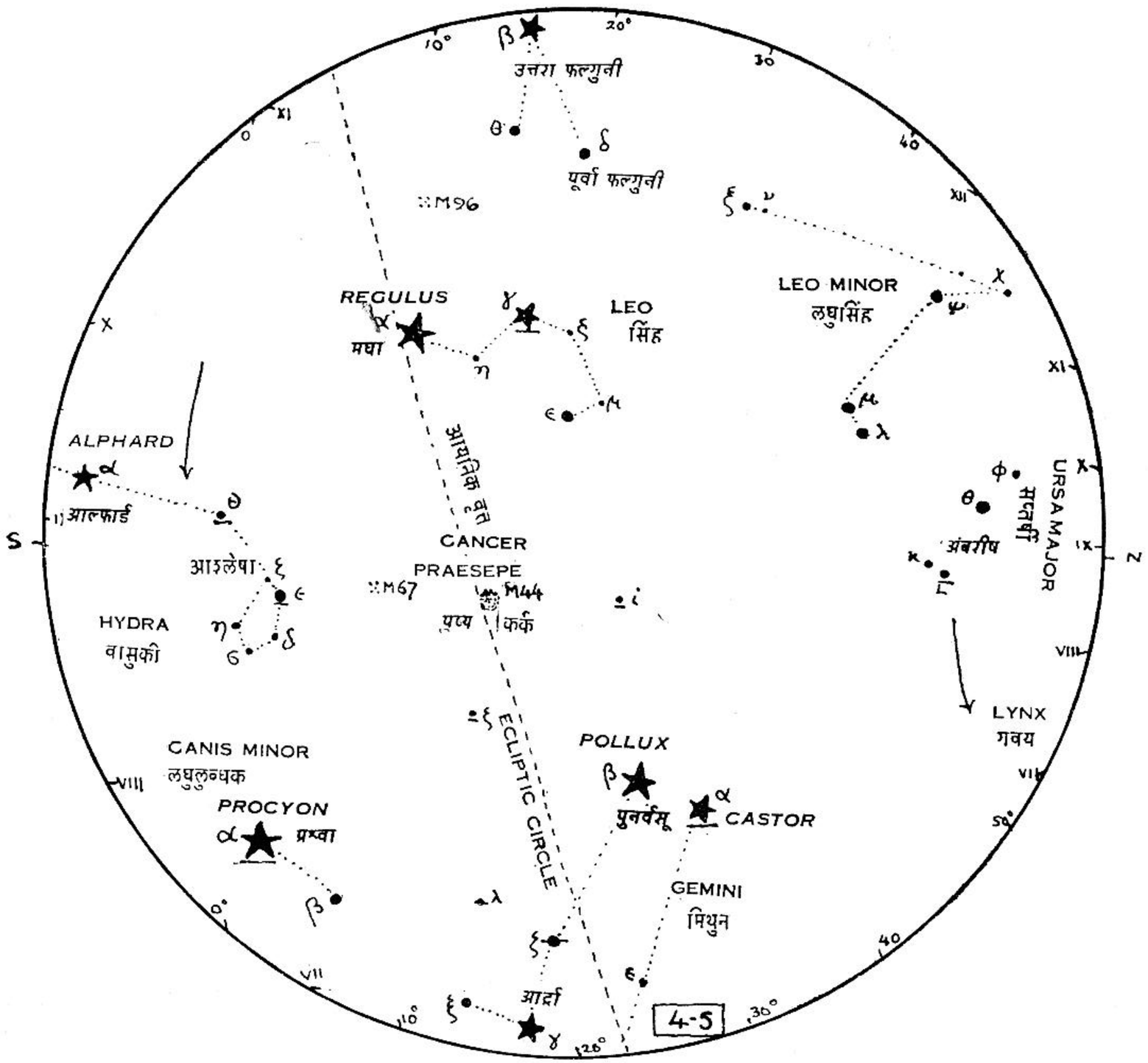
Mensa

THE NAME is modern and it means the Table This constellation remains invisible, being in the southern hemisphere and situated between −70° S and −85° S.

* * *



Observer's Latitude : 25° N

APRIL
ZENITH
KEY-MAP

December	1 at 5 a. m. (I.S.T.)	December	15 at 4 a. m. (I.S.T.)
January	1 at 3 a. m.	January	15 at 2 a. m.
March	1 at 11 p. m.	March	15 at 10 p. m.
April	**1 at 9 p. m.**	**April**	**15 at 8 p. m.**
May	1 at 7 p. m.	May	15 at 6 p. m.

Lupus

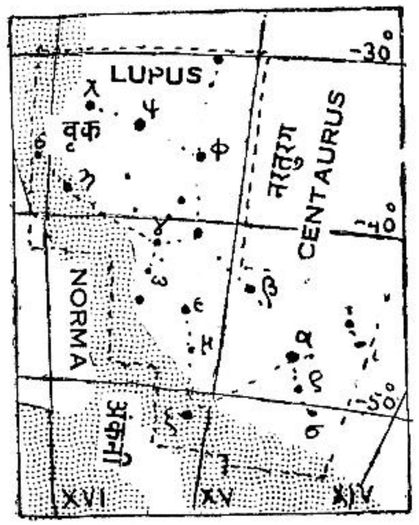


Fig. 4.12 Lupus

THE NAME of the constellation means the wolf. It is situated to the east of Centaurus and to the south of Libra.

According to Hebrew mythology, when after the deluge. Noah left the ship and stepped on land, he offered a Wolf in sacrifice to the Gods. This constellation is believed to represent that wolf.

There are stars of magnitudes 3 and 4.

It is a strange coincidence that the five stars α in Virgo (Spica), α in Lupus, α in Centaurus, α in Circinus and α in Apus are nearly on a line reaching the South Pole. This line is near the Hour Circel XIV. 40'.

* * *

Monoceros

THIS IS a constellation in the Milky Way. The nomenclature is modern. It means the Unicorn. According to Mythology, Orion is mentioned to have hunted a horse with a horn. This is the horse we describe as Unicorn. There are many stars of magnitude 1 and 2 in the neighbourhood but Monoceros proper has none brighter than of magnitude 4. Star β is triple. There is a star cluster, known as N G C 2244 and it offers a good sight with a low-power telescope.

Monoceros and Canis Minor are shown in Fig. 3.7 on Page 73.

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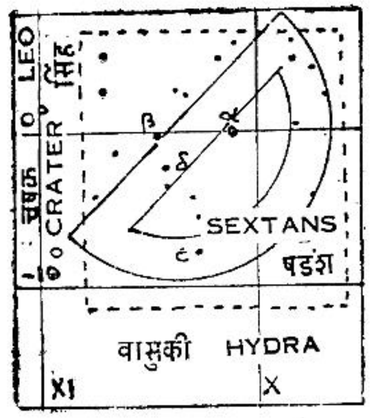


Fig. 4.13 Sextans

Sextans

THE NAME means the Sextant, an instrument for measuring angular distance. The constellation is inconspicuous, the nomenclature is modern and it lies to the south of Regulus (α of Leo). It lies on the Ecliptic and contains no star brighter than magnitude 5.

* * *

Volans

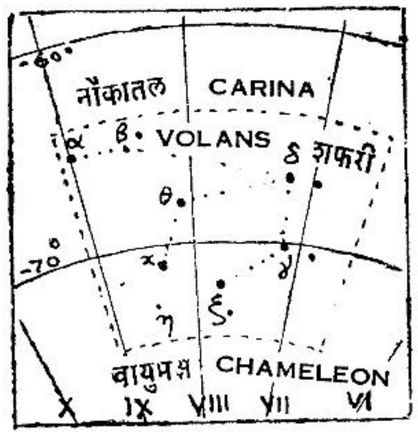
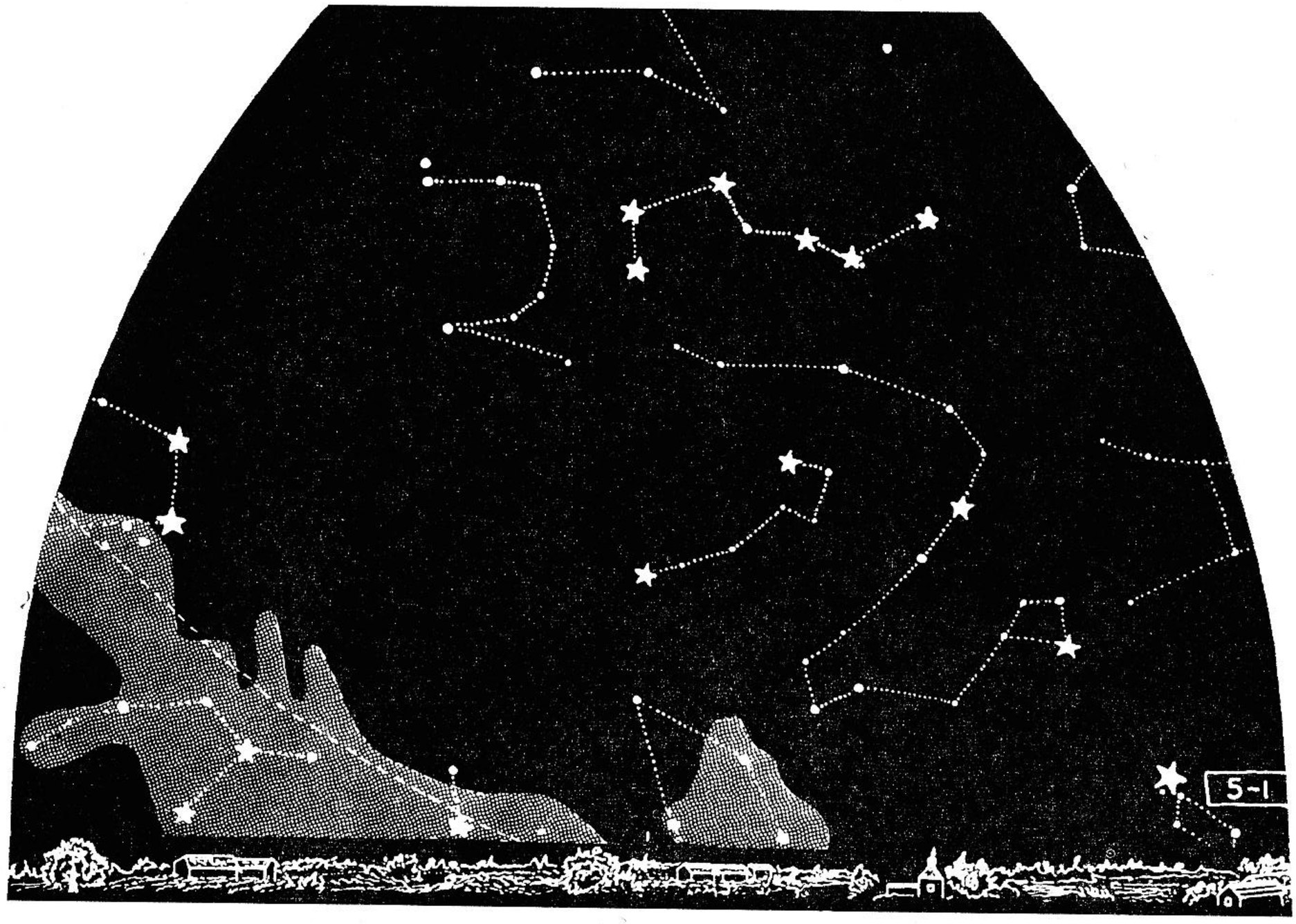


Fig. 4.14 Volans

THIS IS a constellation of the Southern Sky, and it lies between Canopus and the bright star α in Centaurus. The general picture of this constellation is that of a kite with a tail consisting of faint stars. Volans means the Flying Fish and according to mythology, this is the same animal tnat happens to be mentioned in the legend concerning the Ship Argo and the Deluge, on Page 63.

* * *



Observer's Latitude : 25° N

January	1 at 5 a. m. (I. S. T.)			January	15 at 4 a. m. (I. S. T.)
February	1 at 3 a. m.			February	15 at 2 a. m.
April	1 at 11 p. m.	**MAY**		April	15 at 10 p. m.
May	**1 at 9 p. m.**	**NORTH**		**May**	**15 at 8 p. m.**
June	1 at 7 p. m.	**NIGHT-SKY**		June	15 at 6 p. m.

Canes Venatici

THE NAME of the constellation means the Hunting Dogs. It contains among others only 3 stars that are brighter than magnitude 4.5. The constellation is situated in the northern sky between Ursa Major, Bootes and Coma Berenices.

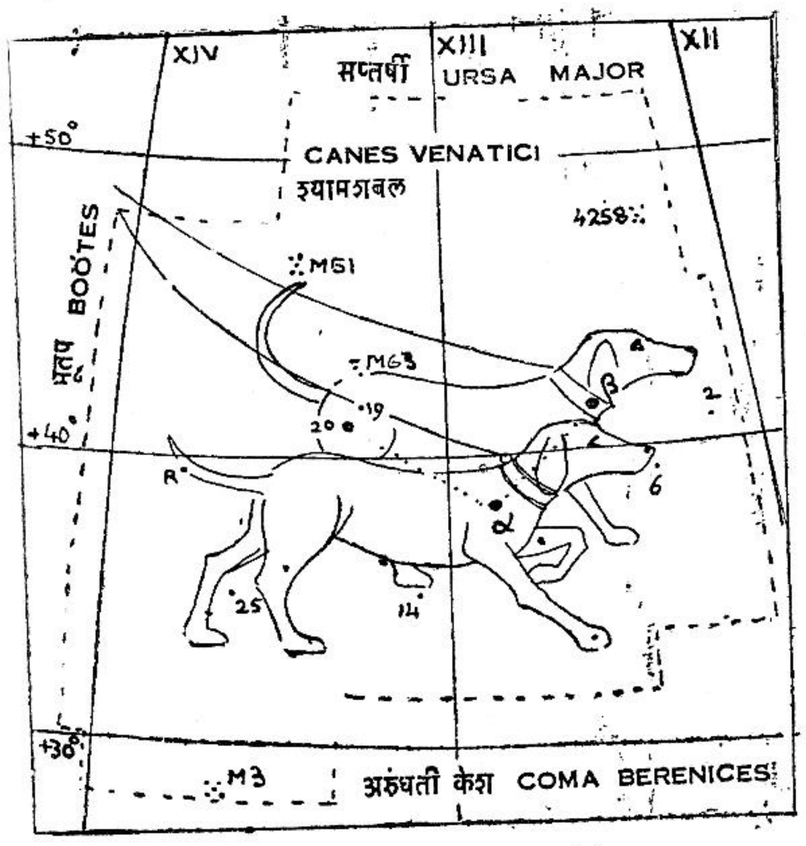


Fig. 5.1 : Canes Venatici

In Greek mythology, Bootes was a Herdsman who had invented the plough for tilling the soil. For this good work he was given a place among the constellations. It can be noticed that the constellation Ursa Major is also called "the Plough". This is probably the article invented by Bootes.

There is another legend according to which Ursa Major * and Ursa Minor ** are really the Great Bear and the Small Bear, representing the mother and her child, Callisto and Arcas respectively.

According to still another legend, Bootes*** represents Arcas, the hunter son of Callisto. The hunter had failed to recognize his mother in the form of a bear. Arcas is therefore shown as chasing the bear with the two Lively Dogs in leash. The group of constellations represents, therefore, Bootes the Hunter, Canes Venatici his two hunting dogs and Ursa Major the bear being chased.

In the pictorial maps, the collar of one of the Hunting Dogs is identified by the star α or Cor Caroli, which means Charles Heart. The star was given this name by the astronomer Halley in memory of Charles I, King of England.

There are many faint stars in this constellation, but it has only three stars that are brighter than magnitude 4.5. The brightest star α, which is also called 12, is a well-known binary and easily resolvable in a 5 cm. telescope. The companions appear coloured "flushed white and lilac".

Underneath star 25, one of the most brilliant globular cluster M3 (NGC 5272) can be seen with naked eyes, under favourable conditions.

On the other side of this star 12 is the bright Spiral Nebula M 51 (NGC 5194), which, however, requires a larger instrument.

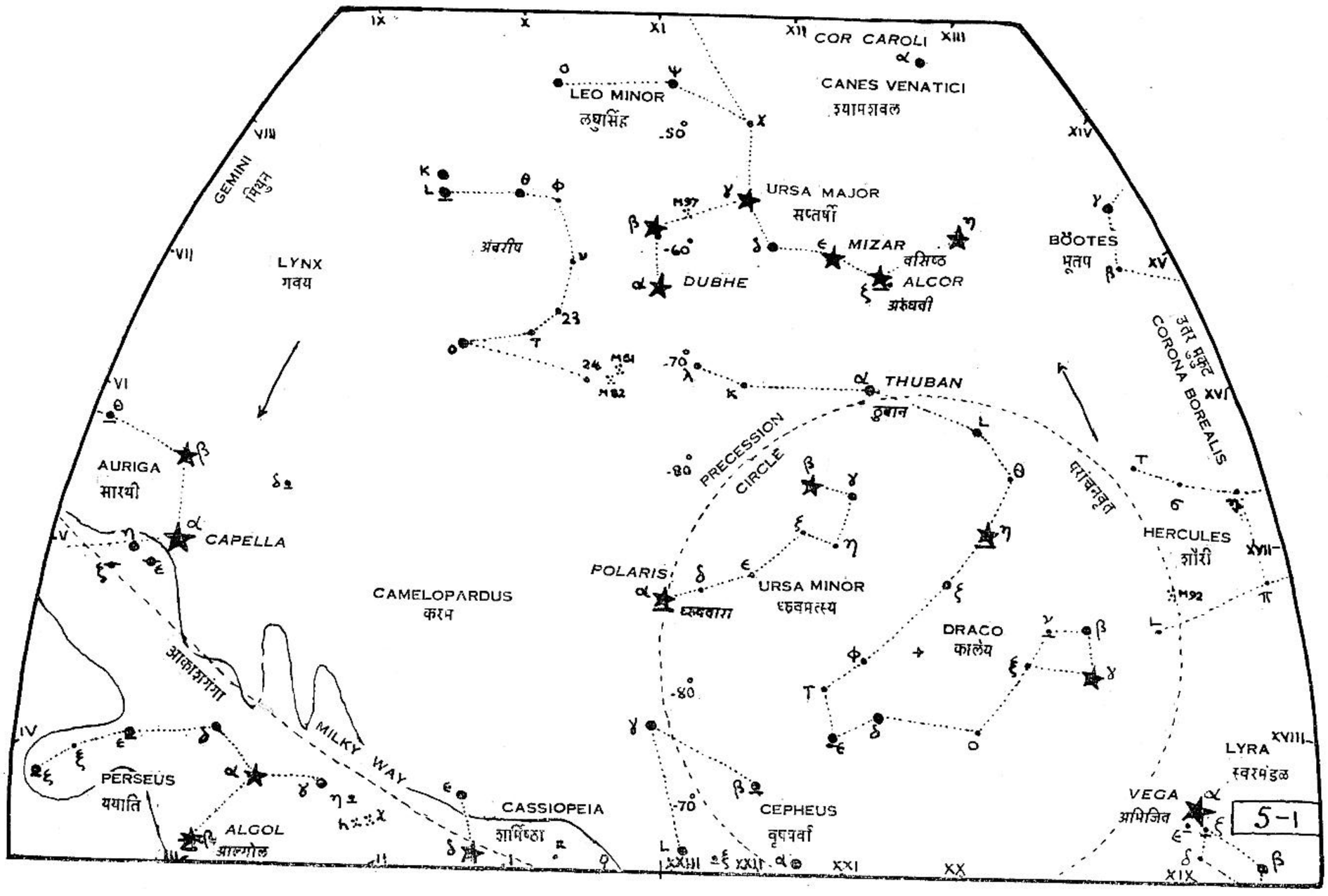
Indian astronomers have given the name *Śyāma Śabala* (श्याम शबल) for this constellation, in memory of the two Dogs of *Yama* (यम) the God of Death, who were called Śyāma (black) and Śabala (spotted) presumably from their appearances.

* * *

* See *Ursa Major* at Page 75

** See *Ursa Major* at Page 115

*** See *Bootes* at Page 119



Observer's Latitude : 25° N

January	1 at 5 a. m. (I. S. T.)		January 15 at 4 a. m. (I. S. T.)
February	1 at 3 a. m.		February 15 at 2 a. m.
April	1 at 11 p. m.		April 15 at 10 p. m.
May	**1 at 9 p. m.**	**MAY NORTH KEY - MAP**	**May 15 at 8 p. m.**
June	1 at 7 p. m.		June 15 at 6 p. m.

MAY : NORTHERN SKY

Prominent Stars :

α in Auriga (Capella).
α in Draco (Thuban) ; former Pole Star.
α in Lyra (Vega) ; future Pole Star.
β in Perseus (Algol).
α and β in Ursa Major (The Pointers) ;
ζ and its neighbour in Ursa Major (Mizar and Alcor).
α in Ursa Minor (Polaris) ; present Pole Star.

Double Stars :

δ in Auriga, seen with a 10 cm. telescope.
γ in Draco, 2 bright stars of equal magnitude, seen with a binocular.
ε, η in Draco, components of different brightness.
β in Perseus (Algol), eclipsing binary, has four components.
ζ in Ursa Major with its neighbour Alcor, seen with naked eyes.
ζ (Mizar) itself is a double for a 5 cm. telescope.
α in Ursa Minor, wide double seen through a 5 cm. telescope.

Veriable Stars :

ε. ζ in Auriga, eclipsing variables with periods 9883 and 972 days.
β in Perseus with a regular period of 2 d. 20 h. 48.9 m.

Nebulae and Star Clusters :

M 92 (NGC 6341) in Hercules beyond π, in line with α, δ, π seen with naked eyes. Both are spectacular objects.
M 81 (NGC 3031) and M 82 (NGC 3034) in Ursa Major ; both can be seen together with a low power telescope.
M 97 (NGC 3587) in Ursa Major between β and γ, known as Owl nebula ; seen with low power.

* * *

Three Models of the Universe

THE UNIVERSE extends far and wide. Its expanse is so great that even the dimensions of the solar system are not large enough to give adequate expression to its vast expanse. It is, therefore, desirable to visualize its dimensions by considering suitable models. Three such models, as suggested by the German authors Widmann and Schuette, are given below.

Model I (Solar system)

This model is based on the solar system. The scale employed in this model is 1 : 10^9, which means :

1000 kilometers in nature = 1mm (in the model).

Assuming the diameter of the Sun to be 1.5 meter, the diameter of Jupitor would be approximately 14 cms. and it would be going round the Sun at a distance of approx. 777 meters.

In this model other measurements would be :

Diameter of the Earth $\underline{\Omega}$ 16 millimeters
Diameter of the Moon $\underline{\Omega}$ 4 mm
Radius of the Moon's orbit about the Earth $\underline{\Omega}$ 40 cm.
Speed of Mercury in its orbit $\underline{\Omega}$ 1 mm in 20 secs.
Speed of Pluto in its orbit $\underline{\Omega}$ 1 mm in 200 secs.
Speed of the Solar system towards Hercules $\underline{\Omega}$ 1 mm in 50 secs.
Speed of light $\underline{\Omega}$ 30 cms in one second
Distance of the nearest Star α Centaurus $\underline{\Omega}$ 40,000 km.
Density of distribution of stars in the Milky Way $\underline{\Omega}$ 60,000 per cubic kilometer

Model II is smaller than Model I by a factor of 1 million.

(Continued on Page 101 Column 2)

Observer's Latitude : 25° N

MAY
EAST
NIGHT-SKY

January	1 at 5 a. m. (I. S. T.)	January	15 at 4 a. m. (I. S. T.)
February	1 at 3 a. m.	February	15 at 2 a. m.
April	1 at 11 p. m.	April	15 at 10 p. m.
May	**1 at 9 p. m.**	**May**	**15 at 8 p. m.**
June	1 at 7 p. m.	June	15 at 6 p. m.

Hercules

THIS IS an extensive constellation, stretching between Corona Borealis and Lyra towards the head of Draco and Ophiuchus.

The figure of the constellation Hercules, in star maps, is like the mirror image of the English letter K.

Hercules was ordered by the Oracle of Delphi to perform Twelve Tasks. For some time Hercules hesitated, but the Oracle revealed to him that if he could successfully carry out his Twelve Tasks, he would become an immortal hero.

When the Greeks placed their divinities among the stars, they had placed Hercules also. Hercules, as seen in the sky in ancient times, was called "the man on his knees". Accordingly, in the star pictures, Hercules is shown as a strong man with his foot on the Dragon's head (Draco)* and a lion's skin on his back. Killing the Lion (Leo) and killing the Sea Snake (Hydra)** were two of his other Tasks. Killing the Crab (Cancer)*** was also considered to be one of his Twelve Tasks. It is said that other constellations, namely, Sagitta the Arrow, Aquila the Eagle, Cygnus the Swan and Draco the Dragon are all memorials in the sky of other great Herculean Tasks.****

The name Hercules was given to the constellation by Eratosthenes. Aratus had called it "En Gonasin' meaning 'the Kneeler'. He is shown as crushing the Dragon's head with his foot. In European latitudes, one can see the figure of Hercules upside down, but it was seen erect by the Babylonians about the time 3000 B. C. A representation of this posture was found on a cylinder seal of that epoch.

* See Draco at Page 135.
** See Hydra at Page 107.
*** See Cancer at Page 71.
**** See Sagittarus (Page 173) Aquila (Page 159) Cygnus (Page 175)

The bright star α, known as. Ras Alghetti, is a red variable. It is also a double star with a companion of magnitude 5. The group of stars δ, μ, ρ, γ seen through a 5 cm- telescope is a rewarding sight.

Star Cluster M 13, between η and ζ and M 92 beyond π in line with α, δ, π, are both fine objects visible to naked eye.

The Sun is moving towards Hercules with a speed of about 20 Km. per second.

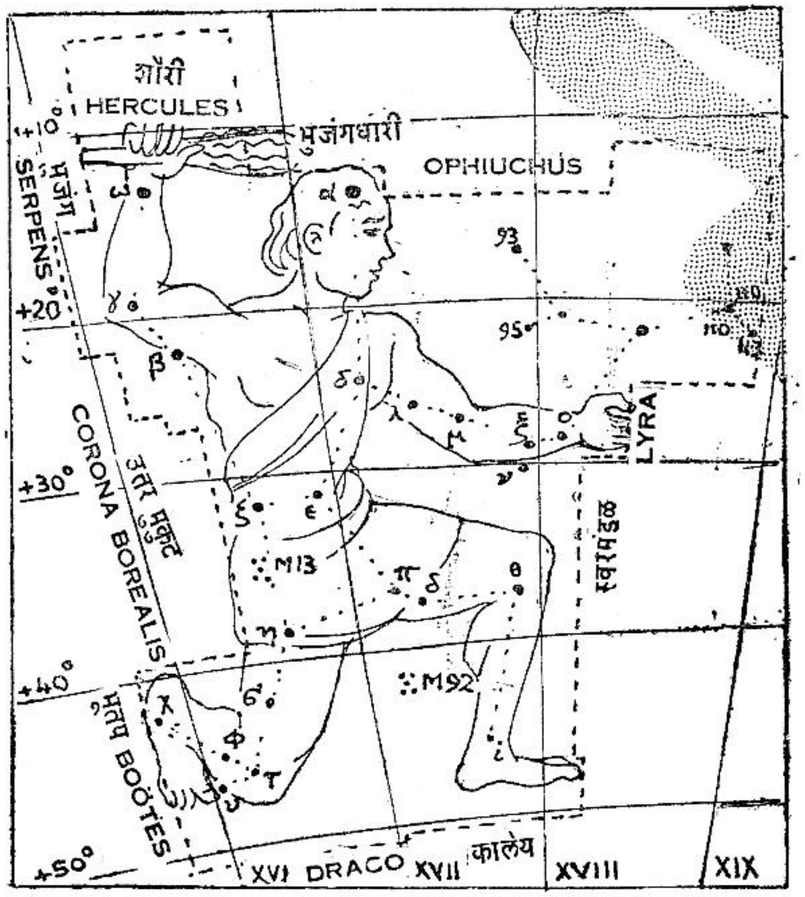
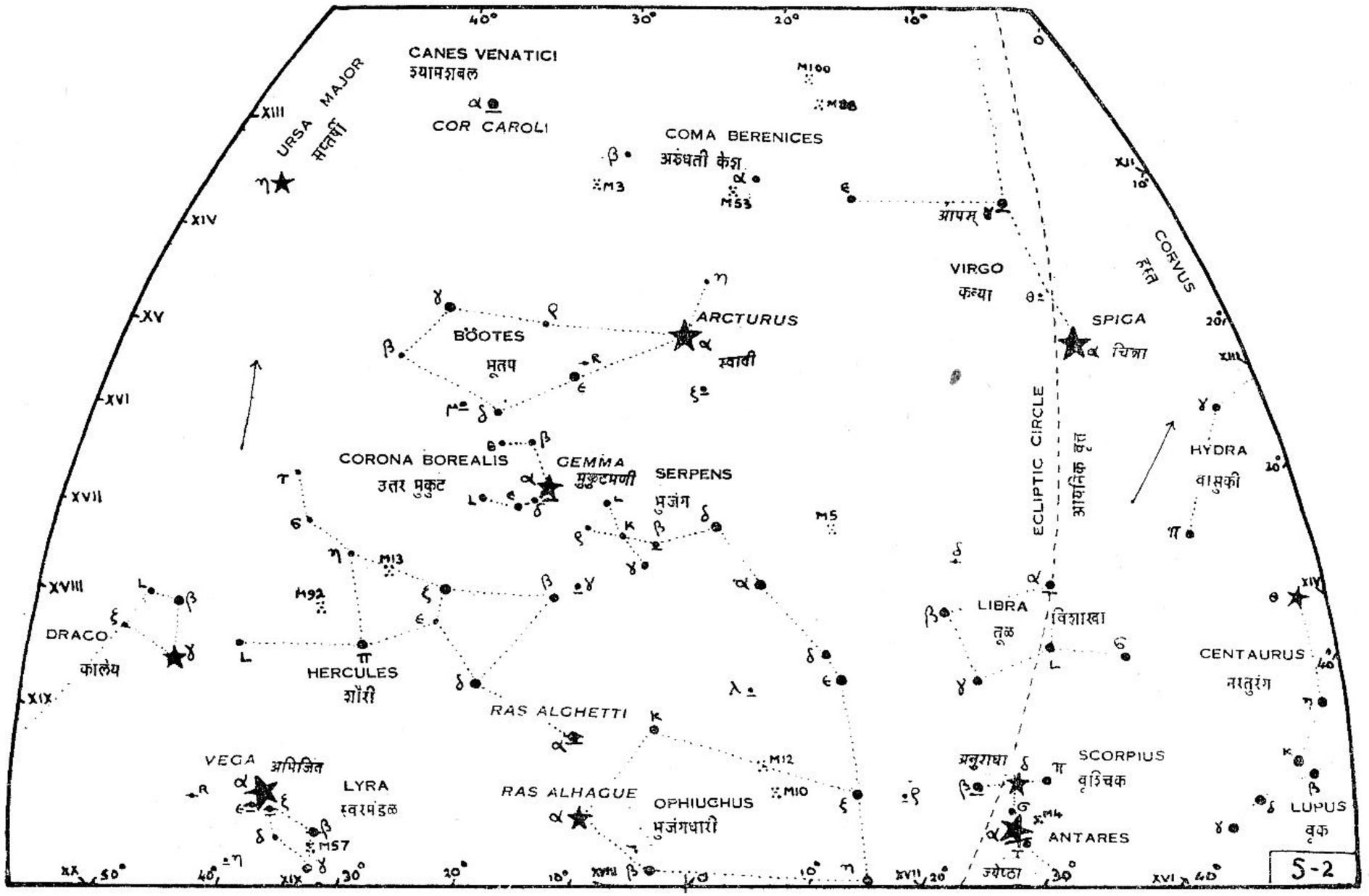


Fig. 5.2 : Hercules

* * *



Observer's Latitude : 25° N

January	1 at 5 a. m. (I. S. T.)			January	15 at 4 a.m. (I. S. T.)
February	1 at 3 a. m.			February	15 at 2 a. m.
April	1 at 11 p. m.	**MAY**		April	15 at 10 p m.
May	**1 at 9 p. m.**	**EAST**		**May**	**15 at 8 p, m.**
June	1 at 7 p. m.	**KEY - MAP**		June	15 at 6 p. m.

MAY : EASTERN SKY

Prominent Stars :

α in Bootes (Arcturus).
α in Canes Venatici (Cor Caroli).
α in Coma Berenices,
α in Carona Borealis (Gemma).
α in Hercules (Ras Alghetti).
β in Leo (Denebola).
α in Lyra (Vega) Pole Star of the future.
α in Scorpius (Antares).

Double Stars :

δ, μ in Bootes, companions fainter than the main by 2 or 4 magnitudes. Seen with field glasses.
δ in Corvus, magnitudes 3.0 and 8.5. Main star is yellow.
δ, μ, ρ, γ in Hercules is a rewarding sight through a 5 cm telescope.
α in Lyra. Optical pair 56″ apart, magnitudes 0.2 and 10.5.
ε in Lyra, wide double 208″ apart, seen with naked eyes.
η in Lyra, 3 small pairs in a low power field-glass.
ζ, β in Lyra wide pairs for binoculars.
α in Scorpius. with a faint component.
β, σ in Scorpius. These are wide doubles.
γ in Virgo, 2 equally bright components, seen with a 5 cm. telescope.

Variable Stars :

α in Hercules varies from 3.1 to 3.9 magnitudes.
β in Lyra, representative of a class of variables; period 12.91 days.

Nebulae and Star Clusters :

M 53 (NGC 5024) in Coma Berenices, above star 42, seen with field glasses
M 100 (NGC 4321) in Coma Berenices, south of star 11; seen with field glasses. Distant spiral galaxy.
M 13 (NGC 6205) in Hercules between η and ζ.
M 92 (NGC 6341) in Hercules beyond π, in line with α, δ, π.
M 57 (NGC 6720) 'Ring Nebula' in Lyra, about half-way on the line joining β and γ, seen through a telescope.
M 4 (NGC 6121) in Scorpius near α. Bright and globular.

* * *

(Continued from Page 97 Column 2)

Three Models of the Universe

Model II (Galactic system)

This model is based on the expanse of the Milky Way and its scale is 1 : 10^9. or 10^9 km in nature = 1 mm in the Model.

According to this scale, some familiar amounts would be :—
Diameter of the Sun Ω the wave-length of light
Radius of Jupitor's orbit Ω 1 mm
Radius of the orbit of Pluto Ω 5 mm
Velocity of light Ω 1/1000 mm per second
Distance of nearest star Ω 40 meters
Diameter of the Milky Way Ω 1000 km
Distance of the Nebula in Andromeda Ω 16,000 km.

Model III is one millionth of Model II

Model III (Extra - galactic space)

The scale employed in this model is 1 : 10^{21}
Based on this scale we shall have the following measurements :—
100 light-years or 10^{15} km in nature = 1 mm in the model
Diameter of the Earth Ω 10^{-12} cm.
Distance of the Sun from the Earth = 1 astronomical unit
Ω 1.5 x 10^{-8} in the model
Average steller diameter Ω 10^{-10} cm.
Diameter of the Milky Way Ω 1 meter
Distance of the nearest Galaxy (in Andromeda)
Ω 16 meters
Other Galaxies would be distributed in space
within a distance of Ω 10 km.
Velocity of light Ω 1 mm per 100 years.

* * *

Observer's Latitude 25° N

January	1 at 5 a. m. (I. S. T.)			January	15 at 4 a.m. (I. S. T.)
February	1 at 3 a. m.			February	15 at 2 a.m.
April	1 at 11 p. m.	**MAY**		April	15 at 10 p.m.
May	**1 at 9 p. m..**	**SOUTH**		**May**	**15 at 8 p. m.**
June	1 at 7 p. m.	**NIGHT-SKY**		June	15 at 6 p.m.

Crux

THIS IS a constellation of the southern sky and it is popularly called the Southern Cross to distinguish it from the northern sky constellation Cygnus* which is also generally pictured as a Cross. Another point of similarity is that both the Crosses lie in the Milky Way. Crux is a small constellation and practically surrounded by the constellation Centaurus.**

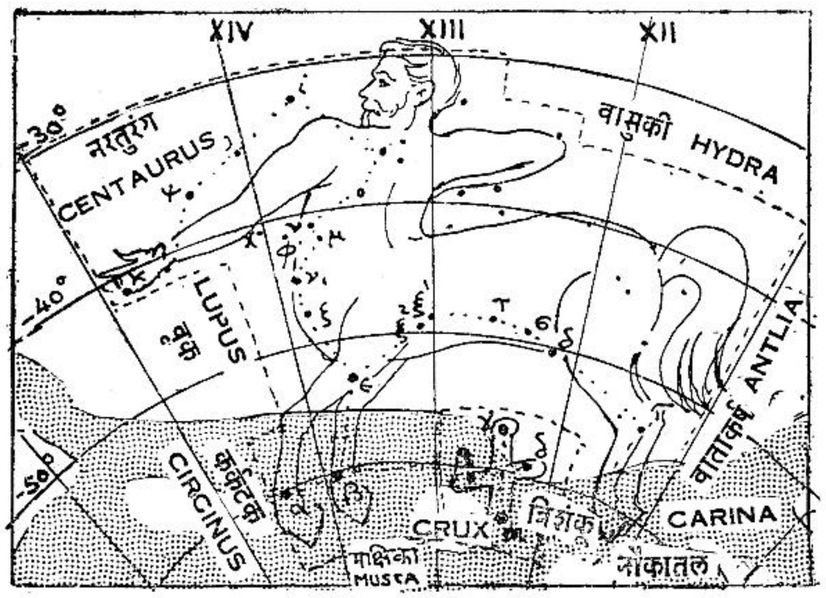


Fig. 5.3 : Centaurus and Crux

Crux is about 30° away from the South Celestial Pole and as such it remains invisible to observers in European latitudes. Astronomer. Al Beruni mentions that a star could be seen from Multan (West Punjab, Pakistan), at Latitude 30° 12′ N and according to him the local name of the constellation was *Śūla* शूल. *Śūla* means the pillar of crucifixion and very probably it refers to the Cross of the Christians. According to a legend, Crux was seen on the horizon of Jerusalem, when Christ was crucified.

Crux is normally not mentioned in books on astronomy designed for European countries. But when some of their navigators reached the southern ocean, they realised the importance of this constellation in fixing the directions in the south, on the same lines as the Pole Star is used in the northern hemisphere.

According to Indian mythology, Crux stands for *Triśaṅku.* (त्रिशंकु). *King-Triśaṅku* had his kingdom at *Ayodhyā.* (अयोध्या). This king was very ambitious. He wanted to enter the heaven with his body intact and with this object in view, he requested sage Vasiṣṭha (वसिष्ठ) to preside over a sacrifice. His request was turned down. *Viśvamītra* (विश्वामित्र), another sage, took pity on the King and offered to help. The sacrifice was organized and the sage *Viśvamitra* invited all the Gods to come down and witness the climbing up of *Triśaṅku* to the heights of the Heaven. The Gods, however, did not enjoy the situation. As soon as *Triśaṅku* approached the gates of heaven, they hurled him down to earth. *Vis'vāmītra,* however, interfered and held the body of *Triśaṅku* suspended between the earth and the heaven. This is the constellation *Triśaṅku* or the Crux.

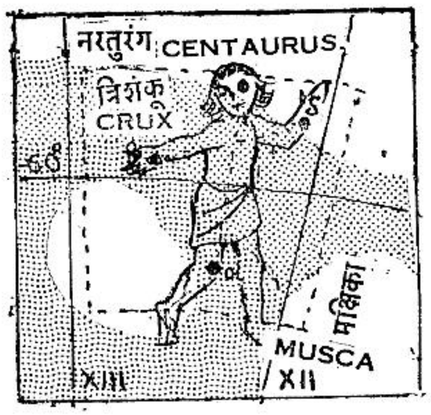


Fig. : 5.4 Crux (*Triśaṅku*)

Stars α and γ are in the north and south directon, while β and γ are directed almost east and west. The star α is bright and is nearer the southern horizon. It is called Austrina or A Crux. It is a first magnitude star and a triplet.

Star κ of Crux is of magnitude 5 but near it there is a beautiful star cluster which is described as a " Box of Jewels ".

γ appears red. It is of magnitude 1.6 and a doublet. The doublet near μ can be seen with a small telescope. The average distance of these stars is about 200 light-years.

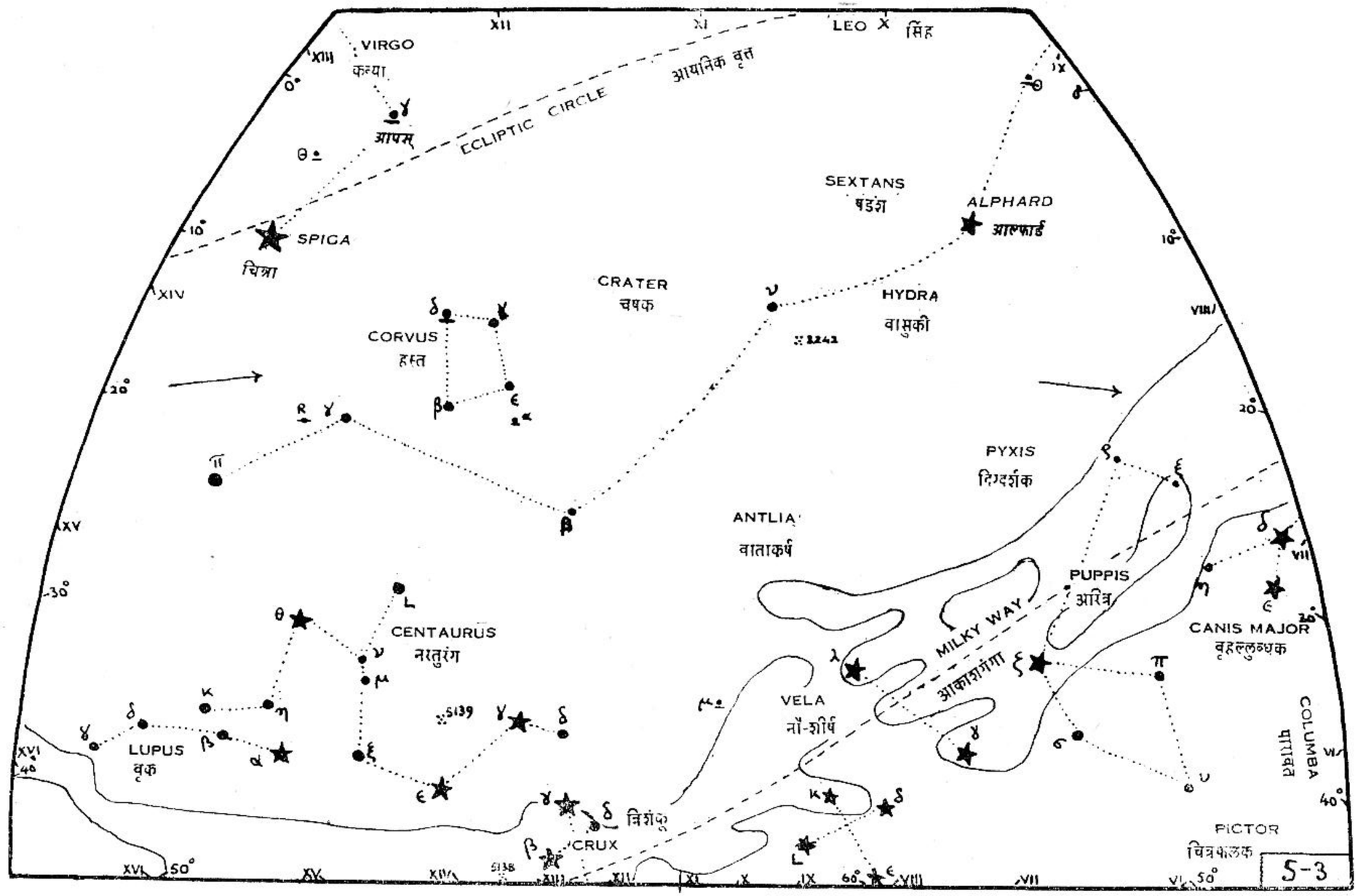
There is a dark region in the Milky Way near Crux and it is belived to be a Dark Nebula.

Just as stars α and β of Ursa Major are called the Pointers, leading to the Pole Star, so are stars α and β of Centaurus called the Pointers leading to the cross-bar of Crux.

* * *

* See Cygnus at page 175

** See Centaurus at page 123



Observer's Latitude : 25° N

January	1 at 5 a. m. (I. S. T.)			January	15 at 4 a. m. (I. S. T.)
February	1 at 3 a. m.			February	15 at 2 a. m.
April	1 at 11 p. m.			April	15 at 10 p. m.
May	**1 at 9 p. m.**	**MAY**		**May**	**15 at 8 p. m.**
June	1 at 7 p. m.	**SOUTH**		June	15 at 6 p. m.
		KEY-MAP			

MAY : SOUTHERN SKY

Prominent Stars :

α in Carina (Canopus)

α in Hydra (Alphard)

α in Lupus, near the horizon towards the east

ζ in Puppis, in the Milky Way

γ and λ in Vela, in the Milky Way

α in Virgo (Spica) lies near the Ecliptic.

Double Stars :

δ in Corvus; magnitudes 3.0 and 8.5; main star is yellow.

α in Crux; magnitudes 1.4 and 1.9; seen with a 2.5 cm. telescope.

0 in Hydra; magnitudes 5.0 and 10.8; seen with a 7.5 cm. telescope.

μ in Vela, fine contrast in components, magnitudes 3.0 & 6.8.

γ in Virgo, both equally bright components, seen with a 5 cm. telescope.

Variable Stars :

l in Carina, Cepheid type, variation from 3.6 to 5.0 magn, period 35.5 days.

Nebulae and Star Clusters :

NGC 3766 in Centaurus. There are about 200 stars, seen with a binocular.

NGC 5139 in Centaurus, noble globular cluster, looks like a tailless comet, 30′ diameter, seen with naked eyes.

NGC 4755 in Crux, surrounding star K which is a fine red star. Star K is near β. Superb piece of jewellery. Contains over 100 coloured stars.

* * *

Surface Temperatures of Stars and their Spectra

SPECTRUM OF a star varies as its surface temperature. A study of stellar spectra, therefore, determines both the nature of the materials and the changes that occur in their physical properties. The accompanying diagram shows the spectral classification in terms of the surface temperatures of some typical stars. The line spectra of six prominent and representative stars, Spica in Virgo, Sirius in Canis Major, Canopus in Carina, the Sun, Arcturus in Boötes and Antares in Scorpius, are indicated in the diagram.

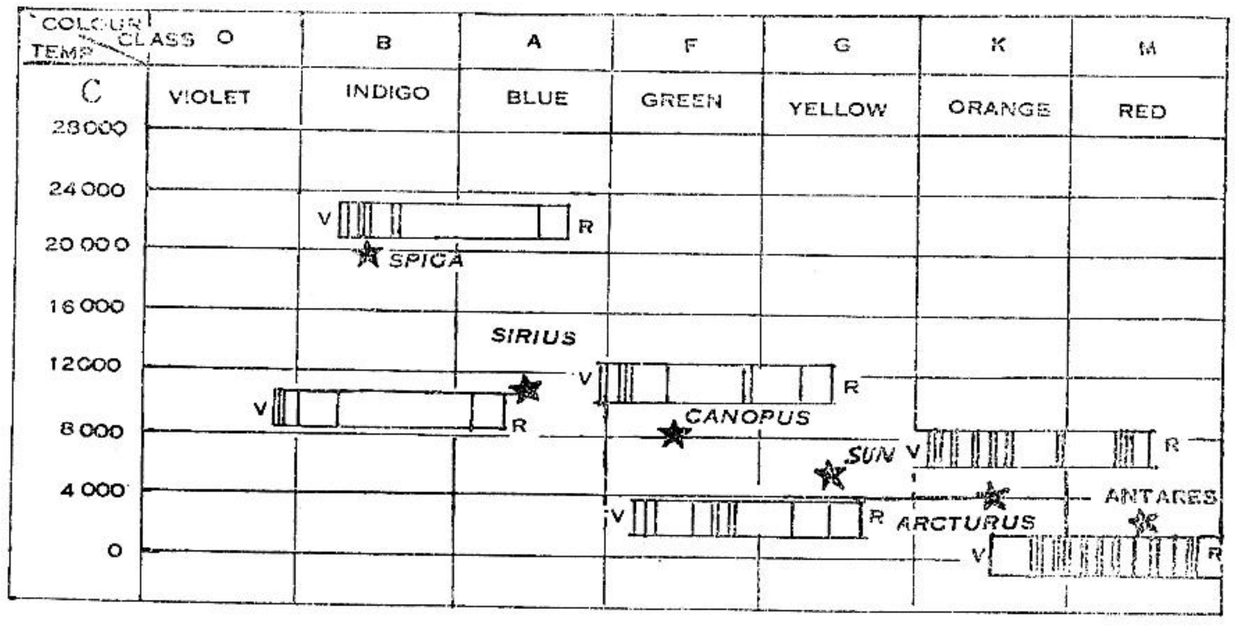
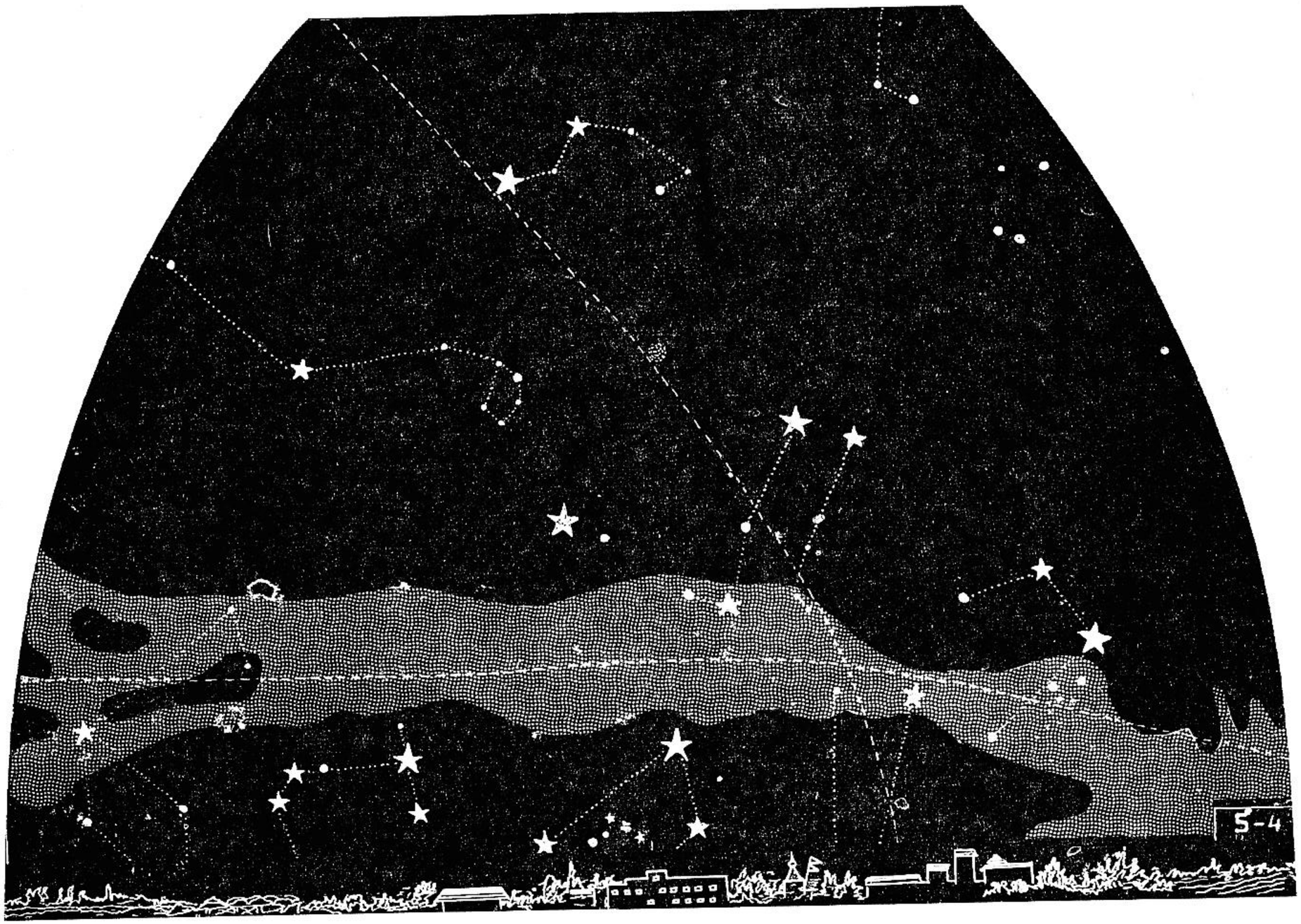


Fig. 5.5 : Stellar temperatures and their spectra.

* * *



Observer's Latitude : 25° N

MAY
WEST
NIGHT-SKY

January	1 at 5 a. m. (I. S. T.)
February	1 at 3 a. m.
April	1 at 11 p. m.
May	**1 at 9 p. m.**
June	1 at 7 p. m.

January	15 at 4 a. m. (I. S. T.)
February	15 at 2 a. m.
April	15 at 10 p. m.
May	**15 at 8 p. m.**
June	15 at 6 p. m.

Hydra

THIS IS a very long constellation of the Southern Sky. Hydra means the Water Snake. The head of the snake lies below Cancer and the remaining part descends lower and lower below the constellations Crater, Corvus and Virgo.

The western legends consider that the Crow (Corvus), near the head of the Snake (Hydra), is feasting on some flesh.

The configuration which shows *Agastya* (अगस्त्य) or Canopus on the western horizon, *Hasta* (हस्त) or Corvus and *Vasuki* (वासुकी) or Hydra, in the middle and *Triśaṅku* (त्रिशंकु) or Crux, towards the south, reminds us of the legend of *Nahuṣa* (नहुष) in Indian mythology. According to this legend, the King *Nahuṣa* was being carried in a palanquin when he was going to see his beloved *Indrāṇī* (इंद्राणी). *Agastya*, the sage, was one of the palanquin bearers. The boastful king wanted to meet *Indrāṇī* without loss of time and therefore he ordered the palanquin bearers to move faster. The word of command that the King used was "*Sarpa, Sarpa*" (सर्प, सर्प) which in Sanskrit means 'Move.' The word has another meaning "Snake." The sages were carrying the palanquin, somewhat against their will, but when they heard the word 'Sarpa' they naturally construed it to mean 'Snake'; felt offended, threw down the palanquin and pronounced a curse. According to the curse, the King *Nahuṣa* was transformed into a snake. This is now the constellation Hydra.

Hercules of Greek mythology was struggling in the marshes with the hundred-headed Hydra. A legend states that when he was only eighteen months old, he had seized two monstrous snakes that had reached his cradle and strangled them to death. But this hundred-headed Hydra was a very dangerous animal. Whenever one of its head was cut off, two new heads were produced instead. Hercules,* finally burnt all the heads, one by one, and buried each of the imperishable heads under, a huge stone.

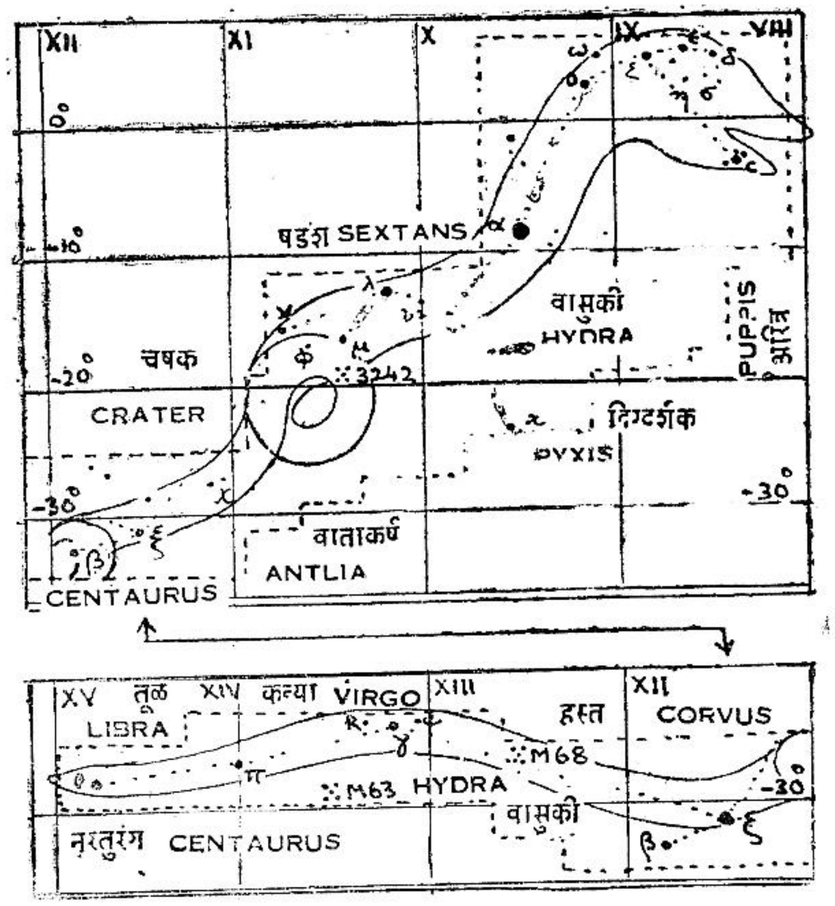


Fig. 5.6 : Hydra

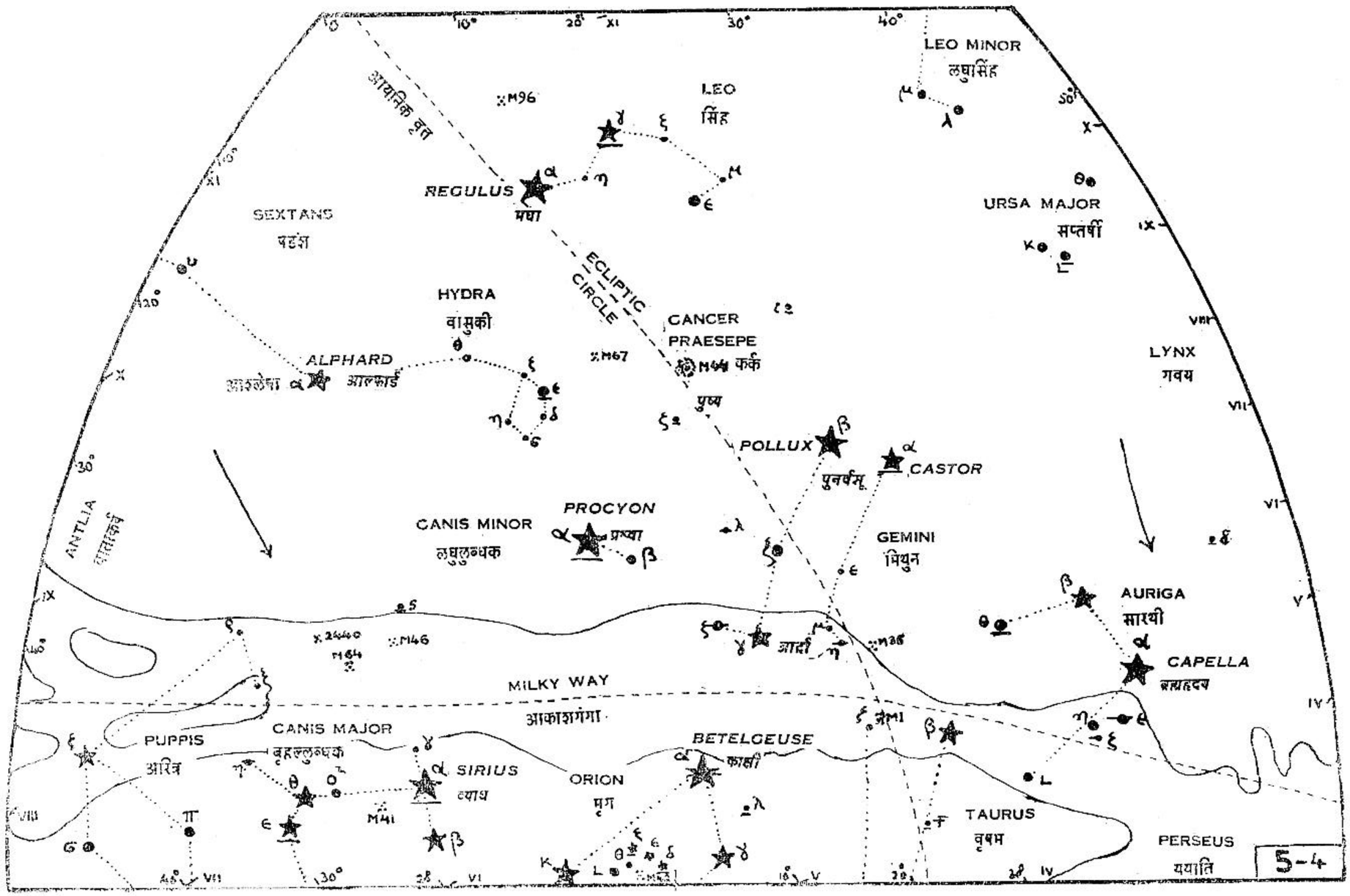
Majority of the stars in Hydra are red in colour. Near its tail and slightly to the east of γ, there is a variable star known as R and it is of the Mira type. Its brightness changes from magnitude 3.5 to 10.1 in 425 days.

The brightest star α of Hydra is red and it is called Alphard. Its magnitude is 2.2. The Chinese, strangely enough, called it "the Red Bird".

The star ζ Hydra is called आश्लेषा (As'leṣa) in Indian mythology.

* * *

* See *Hercules* at page 99.



Observer's Latitude 25° N

MAY
WEST
KEY-MAP

January	1 at 5 a. m. (I. S. T.)	January	15 at 4 a. m. (I. S. T.)
February	1 at 3 a. m.	February	15 at 2 a. m.
April	1 at 11 p. m.	April	15 at 10 p. m.
May	**1 at 9 p. m.**	**May**	**15 at 8 p. m.**
June	1 at 7 p. m.	June	15 at 6 p. m.

MAY : WESTERN SKY

Prominent Stars :

- α in Auriga (Capella).
- α in Canis Major (Sirius).
- α in Canis Minor (Procyon).
- α, β in Gemini (Castor and Pollux).
- α in Hydra (Alphard).
- α in Leo (Regulus).
- α in Orion (Betelgeuse).

Double Stars :

- i in Cancer, seen with field glasses,
- ζ in Cancer, this is a famous triplet,
- α in Canis Major, seen only with a large telescope; companion is a white dwarf of high density.
- α in Canis Minor, companion is faint and white dwarf,
- α in Gemini, this is a sextuple, only two main components can be seen with a 5 cm. telescope.
- δ in Gemini seen with a 5 cm. telescope; yellowish.
- θ in Hydra, magnitudes 5.0 and 10.8, seen with a 7.5 cm telescope.
- γ in Leo, orbital period of 619 years, seen with a 5 cm. telescope.

Variable Stars

- ζ, η in Gemini. ζ is Cepeid type with period 10.2 days. Period of η is 231 days.
- α in Orion, irregularly variable.

Nebulae and Clusters

- M 44 (NGC 2632) " Praesepe " near δ in Cancer, seen with naked eyes; better seen with low power telescope.
- M 67 (NGC 2682) in Cancer near α. Open cluster, seen with a field-glass.
- M 41 (NGC 2287) in Canis Major, 5° below Sirius, seen with naked eyes.
- M 35 (NGC 2168) in Gemini above μ and η,. Contains about 120 stars. Cluster can be seen with naked eyes.
- M 46 (NGC 2437) and NGC 2422 in Puppis, beautiful planetary clusters, on the same latitude as Sirius, seen with field glasses.

* * *

Pair of Clusters in Perseus

SEEN WITH naked eyes, stars in the group known as Pleiades appear to be densely crowded. But looking through a telescope, they can be seen as individual stars and not at all crowded. There is a simple method of expressing the density or the crowded nature of a star cluster. In the space occupied by a sphere of 16 light-years (approximately 5 par-sec) only about 30 to 50 stars can be observed. This density is indeed small and cannot, therefore, be described as a crowd. But in the region occupied by star elusters the density of stars is almost 5 to 10 times larger than the density around the sun. The famous star clusters h and χ in Perseus offer a remarkable sight and the star density in these clusters is very high.

Fig 5.7 : Double Cluster in Perseus

The accompanying picture gives the general appearance of this cluster pair as seen through a 25 cm. telescope.

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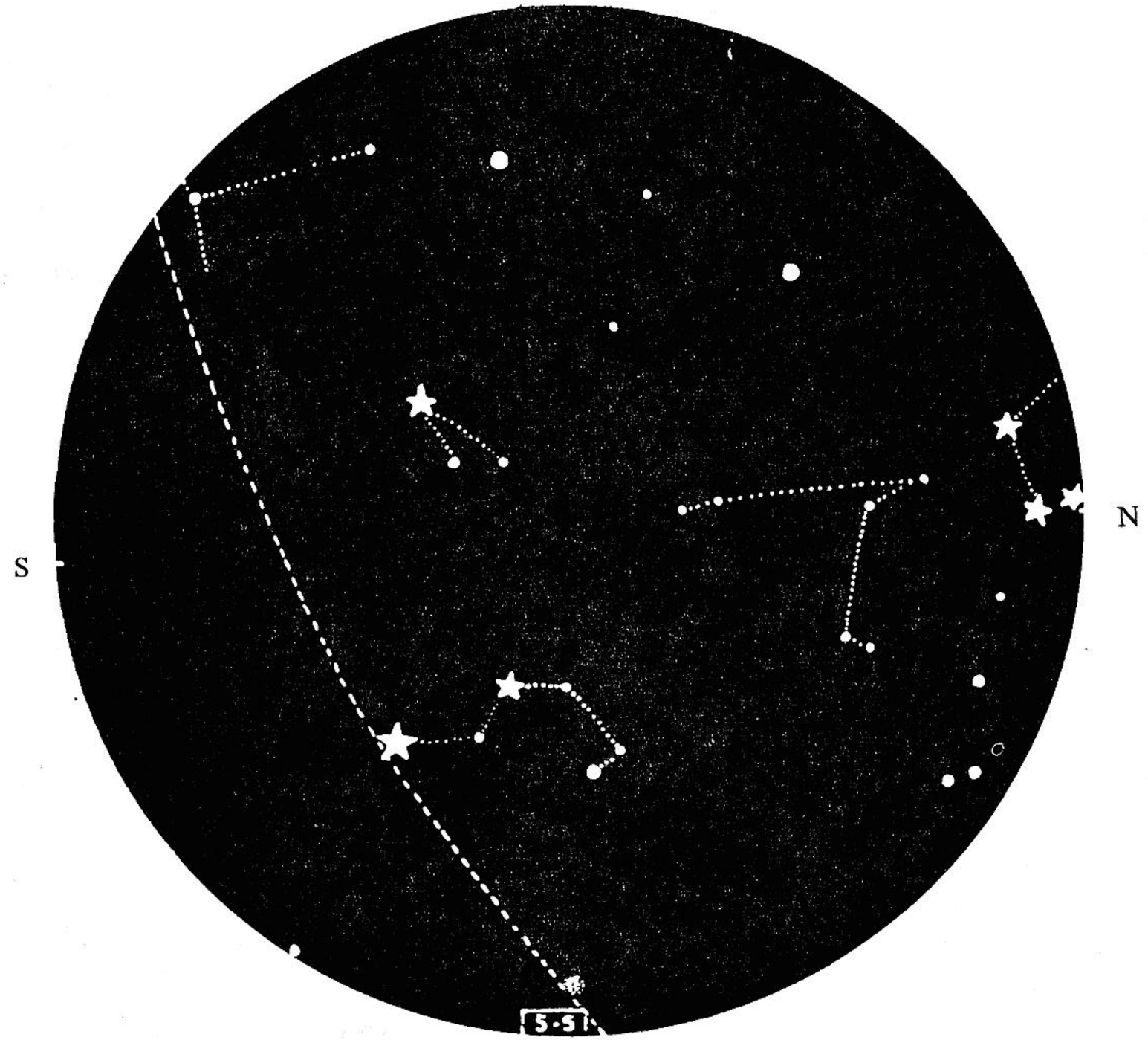


Observer's Latitude 25°N

MAY
ZENITH
NIGHT-SKY

January	1 at 5 a. m. (I. S. T.)	January	15 at 4 a. m. (I. S. T).
February	1 at 3 a. m.	February	15 at 2 a. m.
April	1 at 11 p. m.	April	15 at 10 p. m.
May	**1 at 9 p. m.**	**May**	**15 at 8 p. m.**
June	1 at 7 p. m.	June	15 at 6 p. m.

Star Clusters

STARS APPEAR as twinkling points in the sky and we regard them as individuals. There are, however, some stars which are revealed to be doublets, triplets, quadruplets and so forth, when seen through suitable optical instruments. But there are some stars which are very tightly packed in a very small region so that they appear as Clusters. A field-glass or a binocular is often able to reveal the powerful concentration of stars in a Cluster. These Clusters are known as "Globular" or "Open" according to their form and concentration.

In a Globular Cluster the stars are so thickly concentrated towards the centre that it is often impossible to separate them, if at all, except with the help of the most powerful telescopes. The packing is very close and, according to one estimate, there can be several hundred thousand stars in one single globular structure. There are numerous Globular Clusters and they produce the characteristic halo surrounding the Milky Way.

The famous Globular Clusters are M 13 in Hercules, M 22 in Sagittarius and M 5 in Serpens. The letter behind the number in the nomenclature is taken from the name of the French Astronomer Messier who catalogued them. Globular Clusters are particularly spectacular in the southern sky and, generally speaking, towards the galactic centre. The position can be explained thus. We are in the Solar System which is nearer the edge than the centre of the Milky way. Therefore, we see a greater concentration of the Clusters looking towards the centre than towards the boundary. The Magellanic Clouds* in the southern sky are rich in Globular Clusters.

A Globular Cluster has an average diameter of about 60 parsecs (200 light-years). The stars are often packed several thousand times more closely than in the neighbourhood of the Sun.

Open Clusters contain fewer stars than the Globular Clusters. They only appear as clusters as a result of our position in the galactic plane. It is, therefore, to be regarded either as a local concentration or an optical illusion in the Milky Way system.

Some well-known Open Clusters are the Pleiades (η in Taurus), Praesepe in Cancer and the Hyades (in Taurus). Each of these clusters contains about 100 stars.

There is one very well-known double Star Cluster, known as h and χ in Perseus. (This is described on page 109). It is both famous and interesting. It is visible to the naked eye.

The Open clusters are loose as compared with the Globular Clusters. Even so the space density of stars in a very loose Open Cluster may be 20 to 30 times as great as that in the neighbourhood of the Sun.

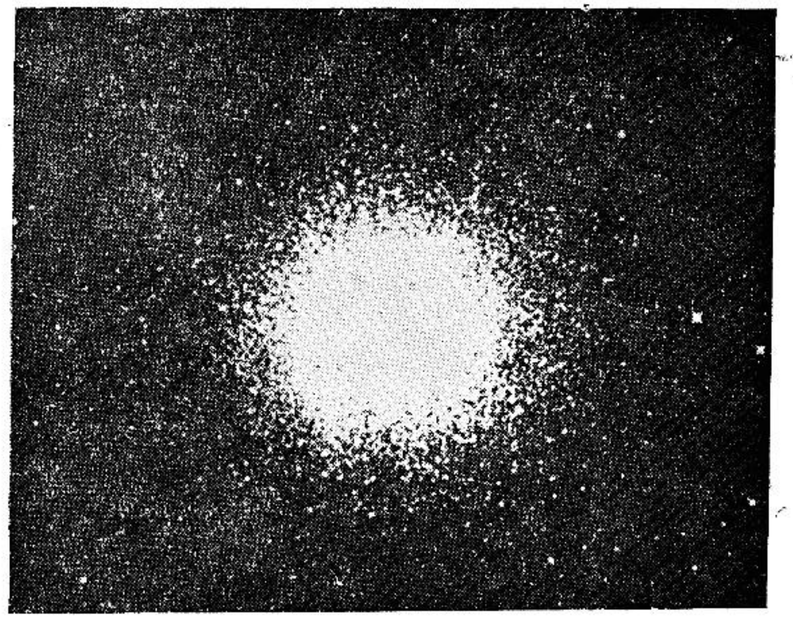
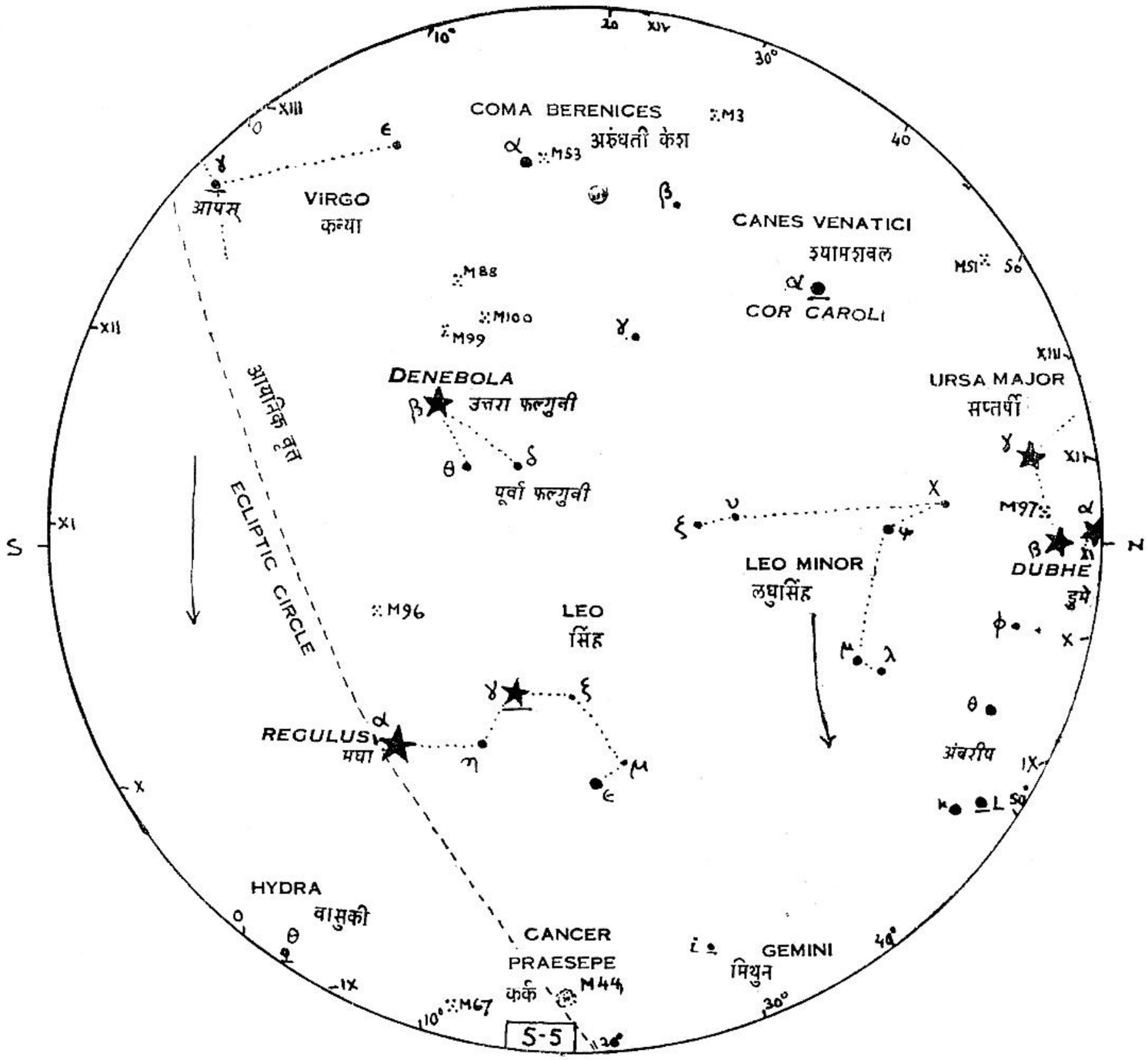


Fig. 5.8 : Star Cluster M 13 in Hercules

* See Magellanic Clouds at page 113.

* * *



Observer's Latitude 25° N

MAY
ZENITH
KEY-MAP

January	1 at 5 a. m. (I. S.T.)	January	15 at 4 a. m. (I. S. T.)
February	1 at 3 a. m.	February	15 at 2 a. m.
April	1 at 11 p. m.	April	15 at 10 p. m.
May	**1 at 9 p. m.**	**May**	**15 at 8 p. m.**
June	1 at 7 p. m.	June	15 at 6 p. m.

Magellanic Clouds

THESE ARE two visible clusters of stars, gas and dust, in the southern sky. They are very far away, being outside our galaxy the Milky Way. They are situated in the sky, in the constellations of Dorado, Mensa and Tucana. The smaller Magellanic Cloud and the larger Magellanic Cloud have their centers approximately near declination circles 73° South and 69° South respectively.

These Clouds are so named after the famous Portuguese navigator, Ferdinand Magellan, who discovered them in the 16th century A.D. These Clouds have been subjects of interest and close study by modern astronomers. The visual diameters of the clouds are 4° and 7° respectively. Being independent galaxies, they are comparable to our galaxy, but the Small and the Large Magellanic Clouds and the Milky Way are situated in different planes in space.

Photographs taken by observers suggest that the distance of the Large Magellanic Cloud is about 50,000 light-years and the distance of the Small Magellanic Cloud is about 22,500 light-years.

The discovery of these Clouds served a very important purpose, namely the establishment of a relation between distance and luminosity. The Magellanic Clouds being so far away from us, we can safely assume that all parts of the Clouds, distant as well as near, are at practically the same distance from us. We can also assume that the apparent luminosities of the distant stars in these Clouds are proportional to their true luminosities. There are many open star clusters and globular star clusters in these Clouds. Thcy also contaiu several Cepheid type variables. Astronomers have now made prolonged and systematic observations of the variable stars, with the help of most modern appliances. They have succeeded in establishing a relationship between the distances of these stars and their apparent magnitudes.

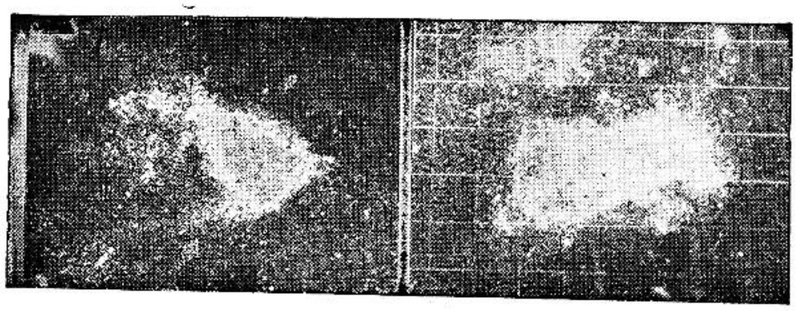


Fig. 5.9 Magellanic Clouds

The method of using the apparent magnitude to estimate the distances is, however, not so easy as it looks. Special and elaborate mathematical calculations have to be made to establish the proper relationship between the star's apparent and real brightness.

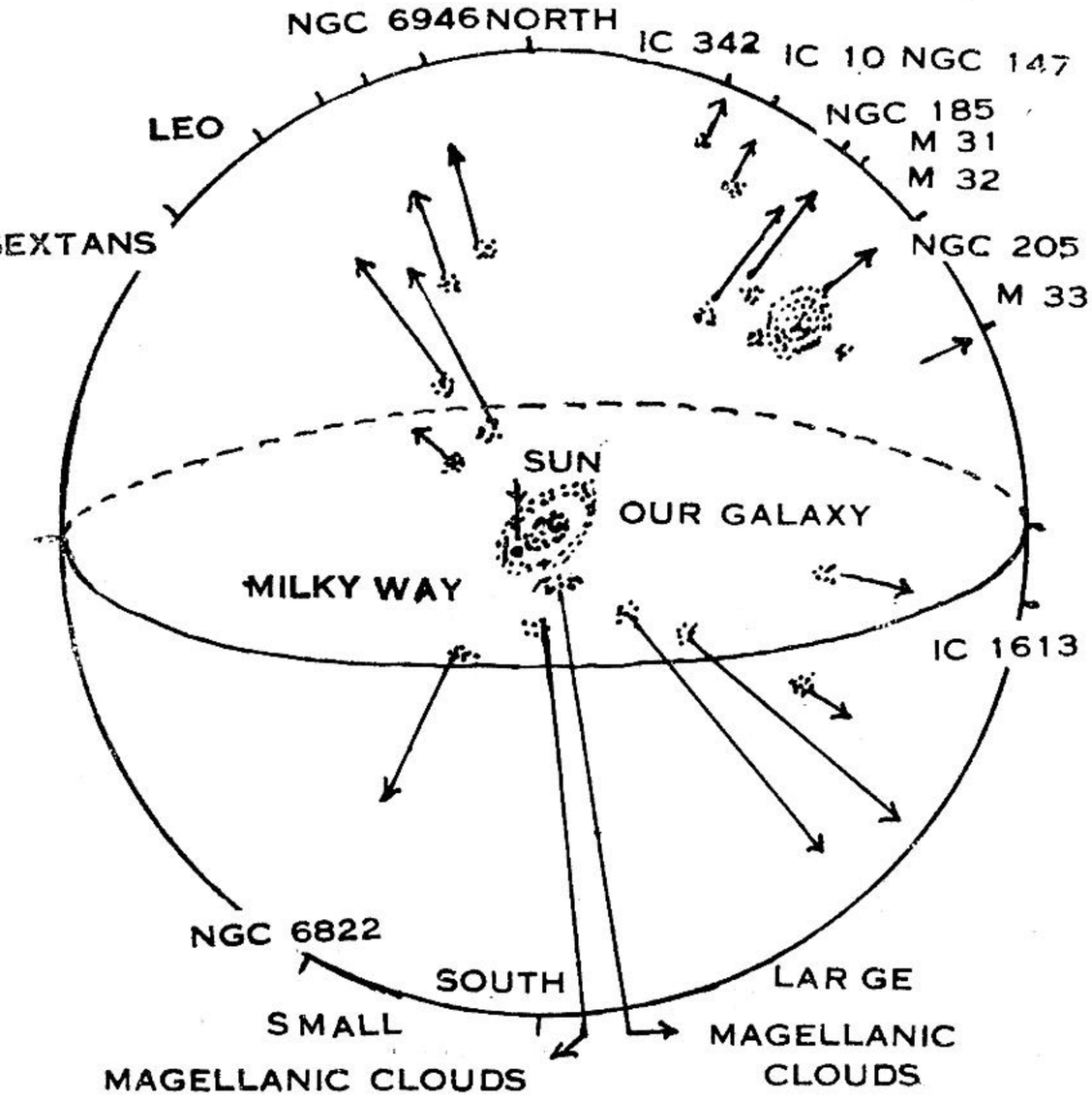


Fig. 5.10 : Position of Magellanic Clouds in the sky.

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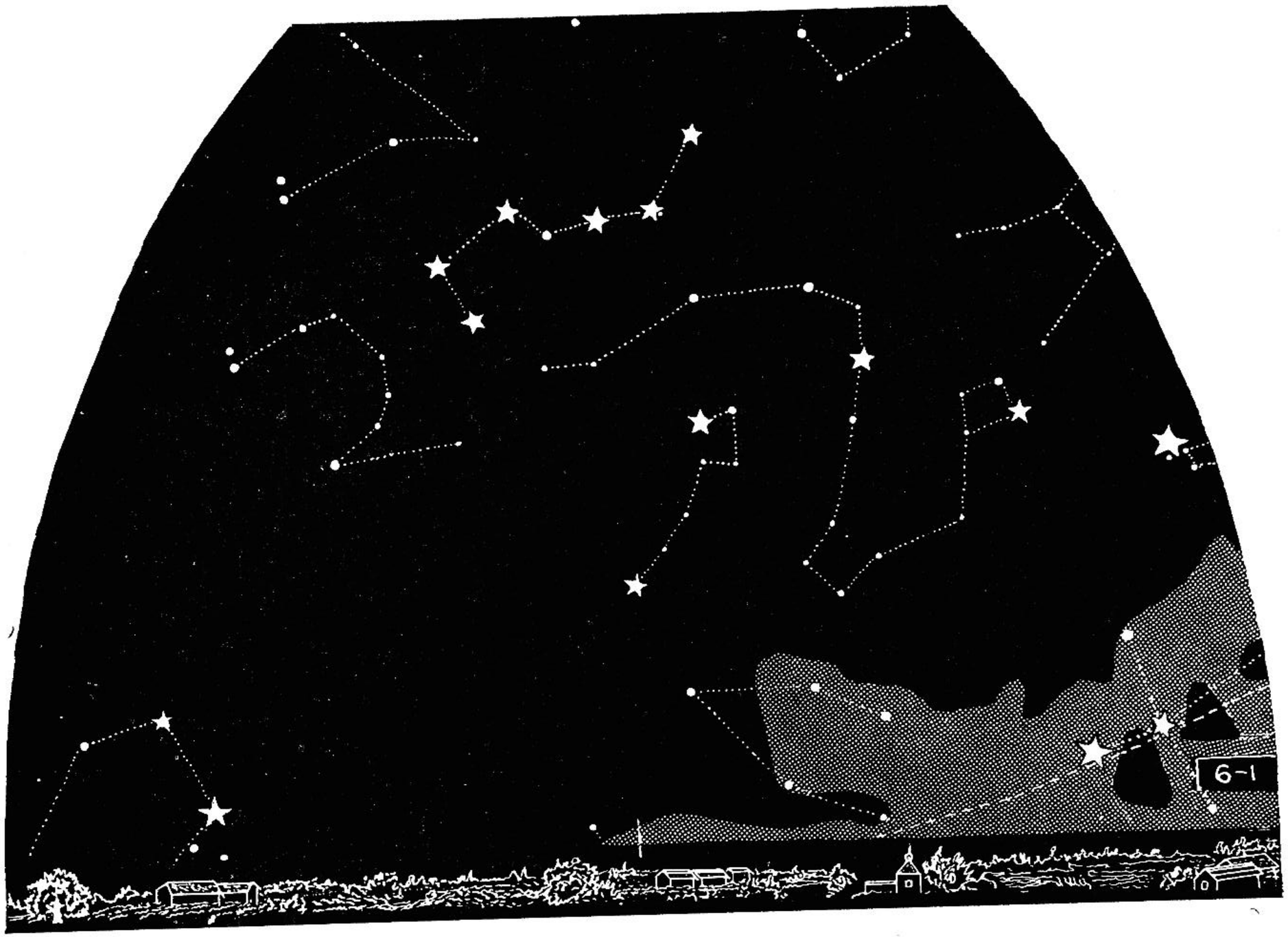


Observer's Latitude : 25° N

JUNE
NORTH
NIGHT-SKY

February	1 at 5 a. m. (I. S. T.)	February	15 at 4 a. m. (I. S. T.)
March	1 at 3 a. m.	March	15 at 2 a. m.
May	1 at 11 p. m.	May	15 at 10 p. m.
June	**1 at 9 p. m.**	**June**	**15 at 8 p. m.**
July	1 at 7 p. m.	July	15 at 6 p. m.

Ursa Minor

THIS CONSTELLATION contains the present Pole Star. The entire dome of the sky, with its stars, turns continuously from the east to the west at the rate of 15 degrees per hour. The axis about which this rotation takes place is called the Celestial Axis. The bright star, which appears closest to this axis, is customarily called the Pole Star.

The entire constellation is visible every night; because to us, situated at about 25° North, it does not go below the horizon at all. It only appears in various positions depending on its place in a cricle about the Pole Star, as its centre.

The geometrical figure of this constellation very much resembles the figure of Ursa Major.* For this reason both are pictured as small Bear and Great Bear respectively.

There are several legends in Greak mythology about these constellations. According to one of them, which is generally favoured, the bears represents the young Hunter Arcas and his mother Callisto. Both were hurled by Jupiter among the constellations, and in that action their tails got pulled out and became longer than usual. Further, the Little Bear has its tail tied up to the axis. And this tail, being under strain, is constantly being extended.

The two stars in Ursa Minor, resembling the Pointers in the Ursa Major, are called the Guards. The idea is that the Guards are keeping watch over the Pole Star so that it remains steady and does not move about or gets lost.

Some legends consider that the constellation resembles a Dog which is caught by the tail and swung round and round continuously.

There is a legend in Indian mythology according to which a prince, by name *Śiṅśumār* (शिशुमार), is standing steadily on the pole Star and is holding tightly in his hands strings of different lengths tied to the different stars in the skies. His intention in doing this is to keep them all revolving incessantly around himself keeping their distances from him and among themselves intact. *Śiṅśumār* is here regarded as the ring master in a circus.

The Indian name of Polaris is *Dhruva Tārā* (ध्रुवतारा) suggesting that it is stationary. At present Polaris is not exactly on the axis. In the year 1950 A. D. it was 1° away from the Celestial Pole but, owing to precessional motion* of the Earth's axis. Polaris will come nearest to the Pole in the year 2095 A. D. and then be only 26' away.

About 4000 years ago, Thuban (α in Draco) was regarded as the Pole Star and after about 12000 years from now Vega (α in Lyra) will become the Pole Star. But that star will not be even so close to the celestial axis as the Polaris is now.

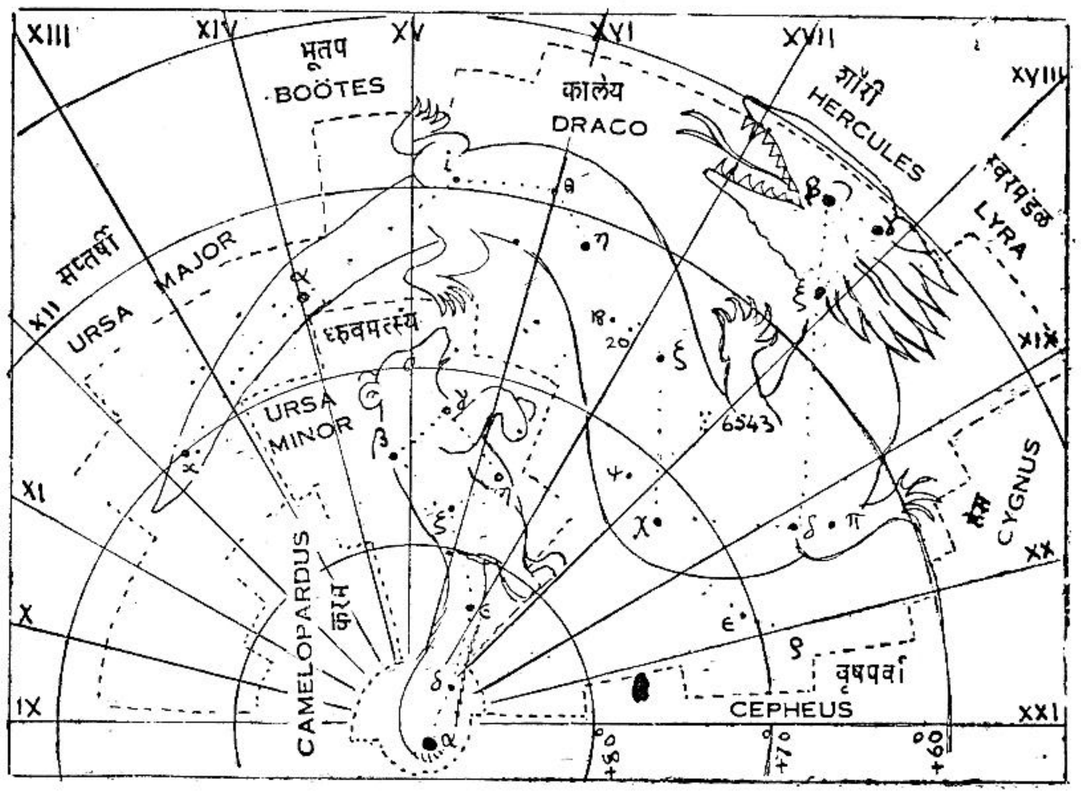
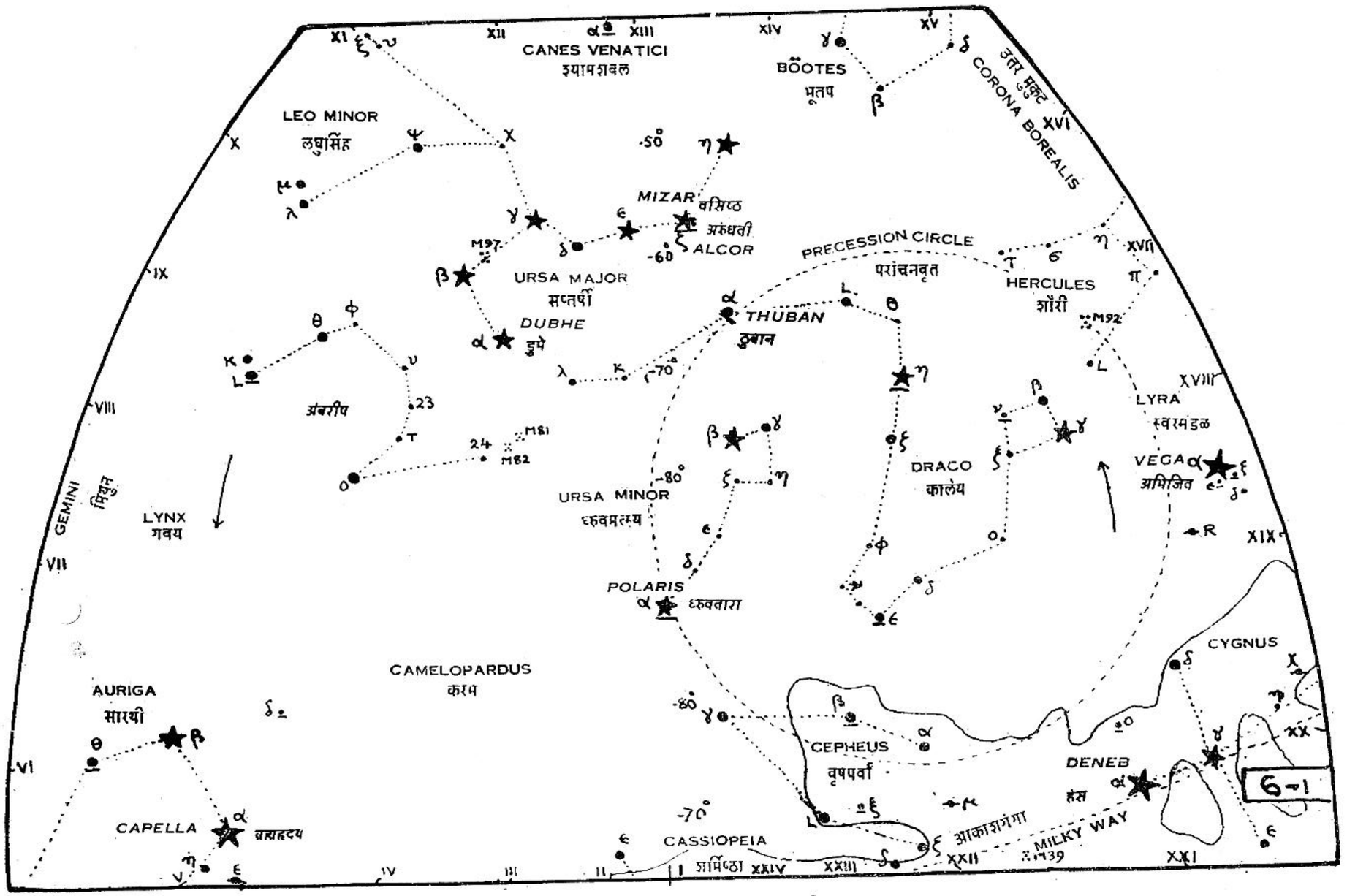


Fig. 6.1 : Ursa Minor and Draco

* See *Ursa Major* at page 75,

* See Precessional Motion at page 57.

* * *



Observer's Latitude : 25° N

JUNE
NORTH
KEY-MAP

February	1 at 5 a. m. (I. S. T.)
March	1 at 3 a. m.
May	1 at 11 p. m.
June	**1 at 9 p. m.**
July	1 at 7 p. m.

February	15 at 4 a. m. (I. S. T.)
March	15 at 2 a. m.
May	15 at 10 p. m.
June	**15 at 8 p. m.**
July	15 at 6 p. m.

JUNE : NORTHERN SKY

Prominent Stars :

α in Cygnus (Deneb).

α in Draco (Thuban), Pole Star of the past.

α in Lyra (Vega), Pole Star of the future.

α β in Ursa Major (The Pointers).

ζ in Ursa Major (Mizar) with its companion Alcor.

α in Ursa Minor (Polaris); Present Pole Star.

Double Stars :

γ in Draco, 2 bright stars of magnitude 5, seen with a binocular.

ε, η in Draco, components of different brightness, seen with a 7.5 cm. telescope.

α in Lyra, optical pair,

ε in Lyra, seen with naked eyes,

ζ, β in Lyra, seen with a binocular.

η in Lyra is a group of 3 small pairs, seen in a low-power field–glass.

ζ in Ursa Major, with its neighbour Alcor, seen with naked eyes.

ζ in Ursa Major, itself is a double, seen with a 5 cm. telescope.

α in Ursa Minor, bluish companion, seen with a 5 cm. telescope.

Variable Stars

α in Hercules, variation from 3.1 to 3.9 magnitudes.

β in Lyra, representative variable, period, 12.91 days.

R in Lyra is an irregular variable.

Nebulae and Star Clusters :

M 92 (NGC 6341) in Hercules beyond π and in line with α, δ, π.

M 57 (NGC 6720) Ring Nebula in Lyra, about half-way on the line joining β and γ, can be seen only through a telescope.

M 81 (NGC 3031) and M 82 (NGC 3034) in Ursa Major, both can be seen together with a low power telescope.

M 97 (NGC 3587) in Ursa Major; between β and γ. The Owl nebula. It can be seen on a clear night with a low power telescope.

* * *

Twinkling or Scintillation

THIS TERM is used to describe the apparent sparkling of stars. It is due to the turbulence of the Earth's atmosphere causing continual small changes in the refractive index of the air. As a result, the brightness of the beam of light that enters the eye from a star is continually changing. In a small telescope, there is the same effect but the star image is also seen to have sideways displacements. In a large telescope, both these effects diminish, but the star image is seen to be much larger than the theoretical image for the telescope objective. The size of the image changes during the night and from night to night. When there are small and steady images, it is said that the 'seeing is good'.

* * *

Observer's Latitude : 25° N

JUNE
EAST
NIGHT-SKY

February	1 at 5 a. m. (I. S. T.)	February	15 at 4 a. m. (I. S. T.)
March	1 at 3 a. m.	March	15 at 2 a. m.
May	1 at 11 p. m.	May	15 at 10 p. m.
June	**1 at 9 p. m.**	**June**	**15 at 8 p. m.**
July	1 at 7 p. m.	July	15 at 6 p. m.

Boötes

THIS CONSTELLATION is to the north of Virgo and Libra. It begins near the tail of the Great Bear. Five stars in Boötes make a longish pentagon and at the tip of the long and tapering corner lies the principal star α known as Arcturus.

The Egyptians regarded Boötes as a Herdsman with the head of an ox. In Greek mythology, one legend considers Boötes to be a Hunter chasing the Great Bear. According to another legend, Ursa Major is really a cart and Boötes is the driver of the cart. Yet another legend makes Boötes the inventor of the plough and regards Ursa Major as the plough itself. The most accepted version, however, is that Boötes was a hunter carrying two lively dogs in leash and chasing the Great Bear.*

Arcturus is the brightest star of the northern sky. Its magnitude is 0.2 and it is shown in the picture at the foot of the constellation The red-coloured star is enormous in size. Its distance is about 32 light years. The luminosity of Arcturus is also very great. If our Sun were placed at the distance of Arcturus, it would shine as a faint and almost invisible star. Arcturus is going away from us with a velocity of about 5 Km. per second. We shall, however, not be able to notice any appreciable change in its brightness in a few years time, because in about 800 years it will have moved through a small distance equal to the apparent diameter of the moon.

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* See *Canes Venatici* at page 95.

Ursa Major or Great Bear at page 75

The other stars in Boötes are β (Nekkar), σ (Izzar), η (Murphid) and μ (Al kalurops).

Stars δ and μ are doubles and can be seen as such through a field-glass. Star R is a long period variable.

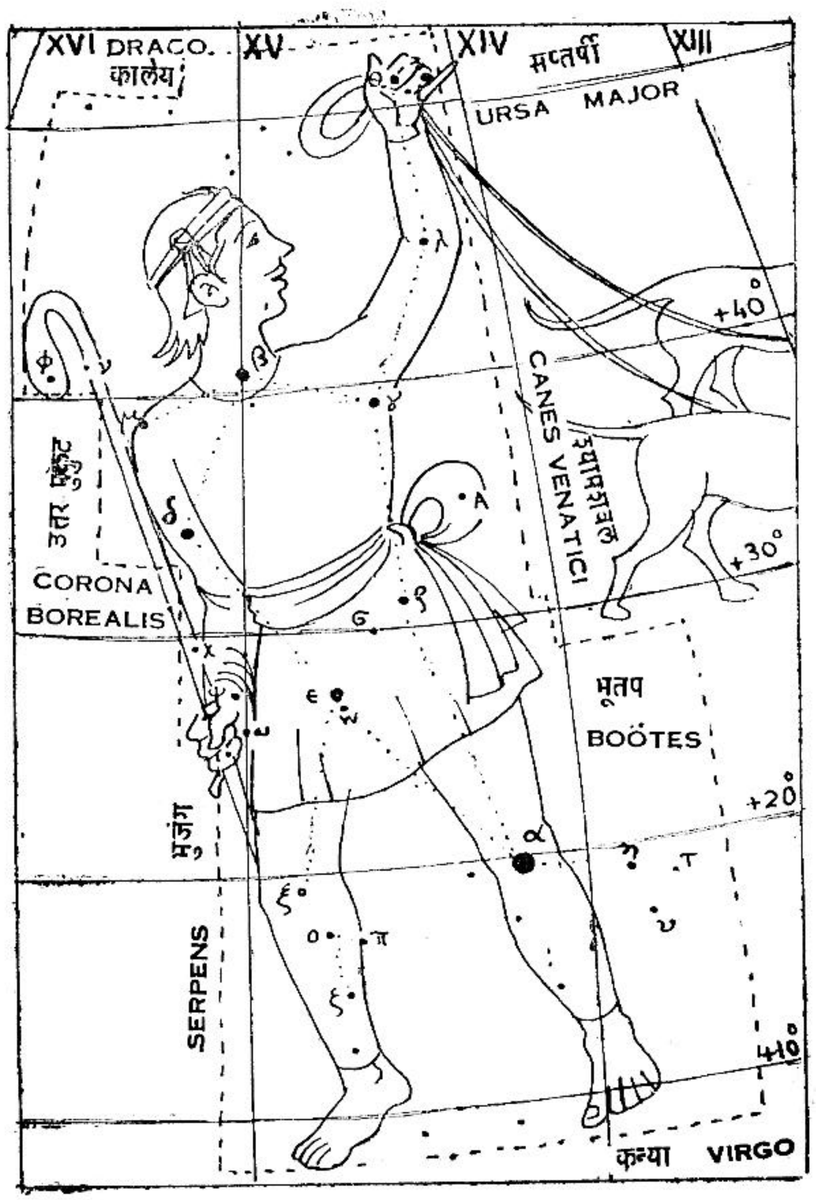

Fig. 6.2 : Boötes

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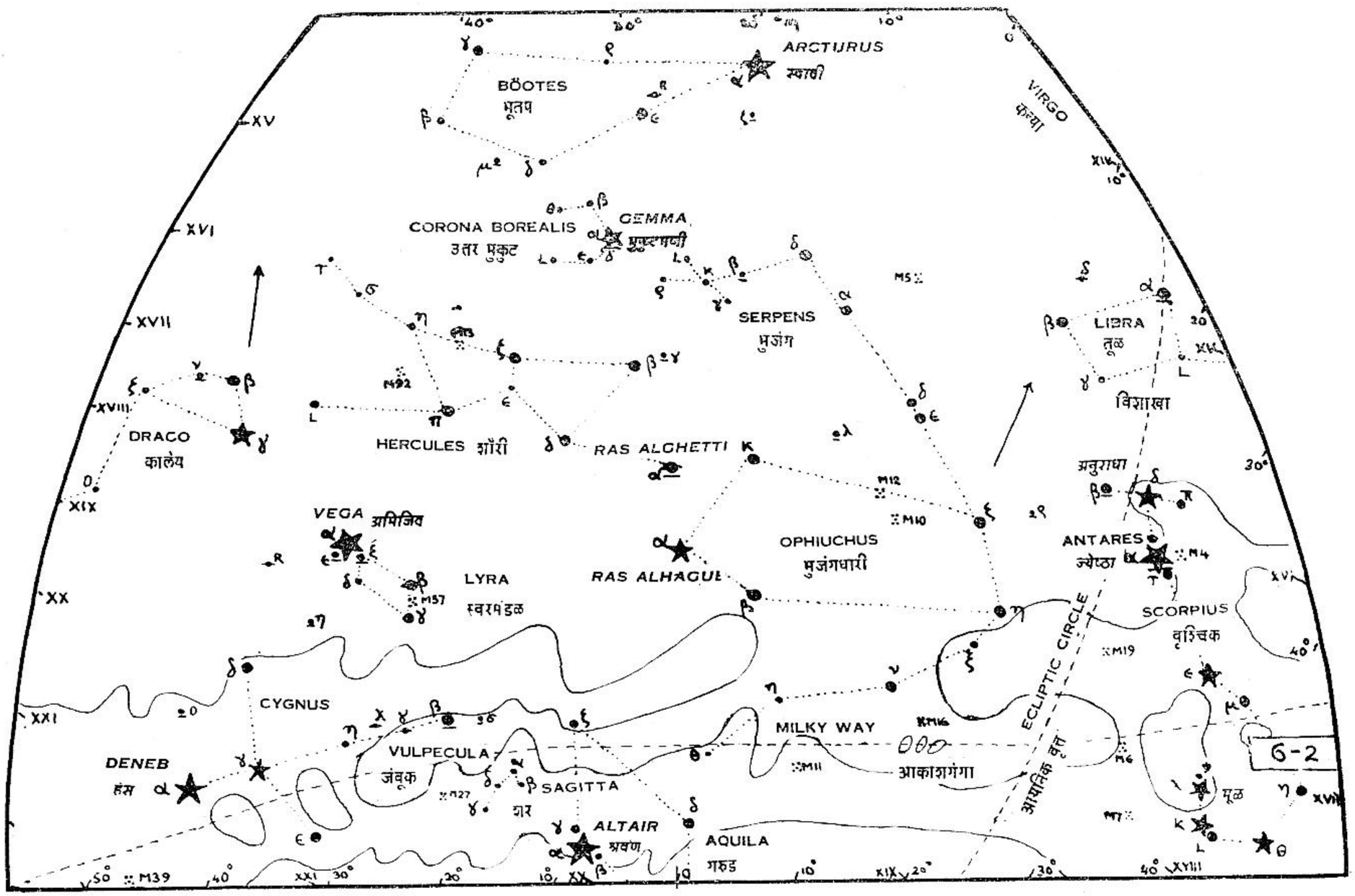


Observer's Latitude : 25° N

JUNE
EAST
KEY-MAP

February	1 at	5 a. m. (I. S. T.)	February	15 at	4 a. m. (I. S. T.)
March	1 at	3 a. m.	March	15 at	2 a. m.
May	1 at	11 p. m.	May	15 at	10 p. m.
June	**1 at**	**9 p. m.**	**June**	**15 at**	**8 p. m.**
July	1 at	7 p. m.	July	15 at	6 p. m.

JUNE : EASTERN SKY

Prominent Stars :

α in Aquila (Altair).

α in Boötes (Arcturus).

α in Corona Borealis (Gemma).

α in Cygnus (Deneb).

α in Hercules (Ras al Ghetti)

α in Libra (Zuben al Genuti).

α in Ophiuchus (Ras al Hague).

α in Serpens (Cor Serpentis).

α in Scorpius (Antares).

Double Stars :

δ, μ in Boötes, companions are 2 to 4 magnitudes fainter than the main; seen with field glasses.

α in Corona Borealis, well-known double, seen with a 5 cm. telescope.

β in Cygnus seen with field glasses.

α in Hercules, with a blue companion of magnitude 5.

α in Libra, wide double 230″ apart.

Star 70 in Ophiuchus, between η of Serpens and β of Ophiuchus. Yellow and red. Seen with a 5 cm. telescope.

0 in Serpens (Tail Star) seen with field glasses.

α in Scorpius with a faint companion, components are red and green.

β, ν, σ in Scorpius, wide doubles. Each component of ν is a double.

ξ in Scorpius, seen with a 5 cm. telescope.

Voriable Stars :

α in Hercules, varies from 3.1 to 3.6 magnitudes.

δ in Libra, Algol type, varies from 4.8 to 6.1 magnitudes.

Nebulae and Star Clusters :

M 13 (NGC 6205) in Hercules between η and ζ, seen with naked eyes.

M 92 (NGC 6341) in Hercules beyond π in line with α, δ, π, seen with naked eyes.

M 57 (NGC 6720) in Lyra between β and γ, Ring nebula, only seen through a telescope. It is 1700 light-years away.

M 10 (NGC 6254), M 12 (NGC 6218), M 19 (NGC 6273) in Ophiuchus. These are considerably faint.

M 5 (NGC 5904) in Serpens near α, very bright and can be seen with naked eyes.

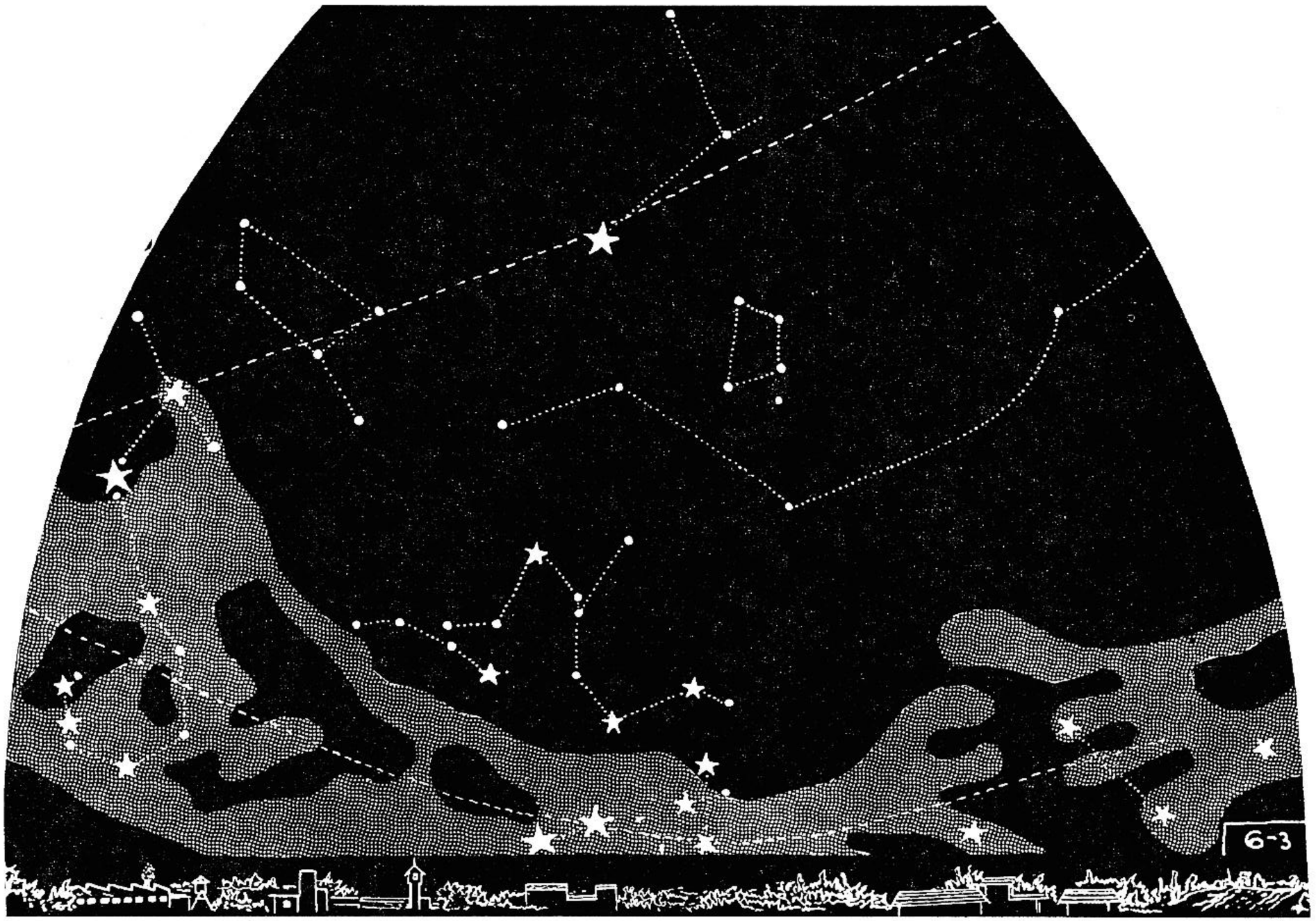
NGC 6633 in Serpens, near θ, belongs really to Ophiuchus. Can be seen with field glasses.

* * *

Transit

TRANSIT ACROSS or going over. In astronomical processes a transit occurs when an inferior planet (Mercury or Venus) as seen from the Earth moves across the Sun's disc, or a satellite moves across the disc of a planet, generally across Mercury, Venus, Jupitor etc. A star is said to transit at the moment when the diurnal motion takes it across an observer's meridian.

* * *



Observer's Latitude : 25° N

February	1 at 5 a. m. (I. S. T.)			February	15 at 4 a. m. (I. S. T.)
March	1 at 3 a. m.			March	15 at 2 a. m.
May	1 at 11 p. m.			May	15 at 10 p. m.
June	**1 at 9 p. m.**	**JUNE**		**June**	**15 at 8 p. m.**
July	1 at 7 p. m.	**SOUTH**		July	15 at 6 p. m.
		NIGHT-SKY			

Centaurus

THIS CONSTELLATION is to the south of Hydra and to the east of Argo. The Arabic name of the bright star is Al Kentaurus and it very much resembles the Greek name with slight modifications.

The Egyptians considered this Centaur to be "Noah" and the Indians regarded him as "*Manu*" (मनु) mentioned in connection with the deluge. The ship "Argo" that saved the human race is made out of the neighbouring constellations (Vela, Pyxis, Puppis, Carina).

According to Greek mythology, Centaurs were the children of Apollo. Centaurs belonged to a savage race of Thessaly who were addicted to wine, women and war, and in most mythological narratives, they are described as half-man and half-horse. One of these Centaurs, Chiron by name, was known everywhere for his goodness and wisdom. As such, most of the young sons of contemporary heroes were sent to him for training. Chiron was the only Centaur* who was immortal and yet he died in the end and went down to the lower world. Hercules, the great warrior, was indirectly and quite inadvertently the cause of Chiron's death. The legend about this incident is quite interesting. Hercules, on one occasion, called on his friend Pholus and, being thirsty, asked him for a drink and got it. The wines being the common property of all the Centaurs, it appears that Pholus by himself had not the authority to offer a drink. Anyway, a misunderstanding was the result, protests were made and a fight ensued. In the confusion, Hercules accidentally wounded Chiron with his poisoned arrow. The arrow was coated with the poisonous blood of the monster Hydra. It was an accident. Chiron had taken no part in the fight, but the poisoned arrow shot by Hercules resulted in his death. Chiron was immortal, but being hit with a poisoned arrow, Jupiter permitted him to die, and as a reward placed him among the constellations.

The star α in Centaurus ranks third among the brightest stars of the night sky. α consists of two big stars of magnitudes 0.3 and 1.7. It is the second nearest star being only 4.3 light-years away from us. The Sun's distance is 8.5 light-minutes. Both the companions in α are of equal size, about the same as that of the Sun. The period of revolution of the partners about their common center of gravity is about 79 years. There is a third companion to this star α and it is called Proxima Centauri being still nearer to us than the others. Proxima goes round the others in a period of about 300,000 years.

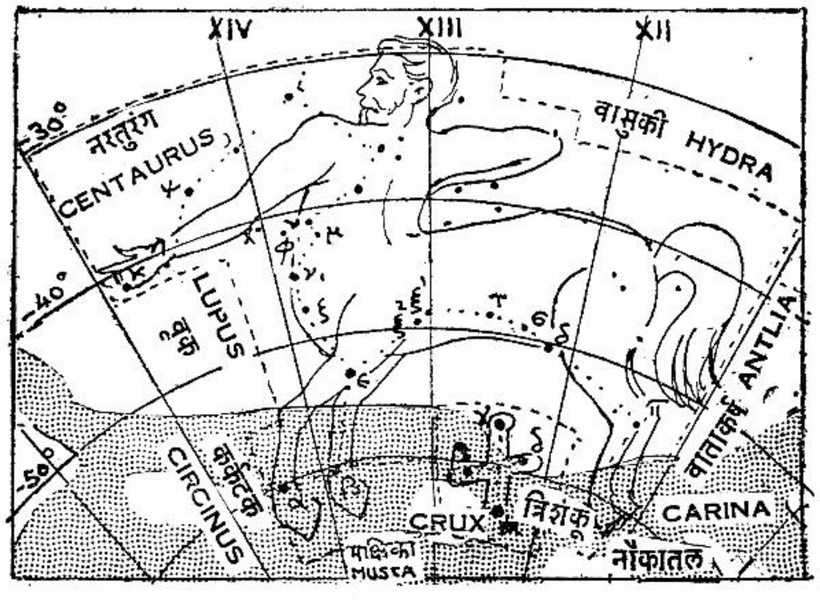


Fig. 6.3 : Centaurus and Crux.

* See *Sagittarius* at page 163.

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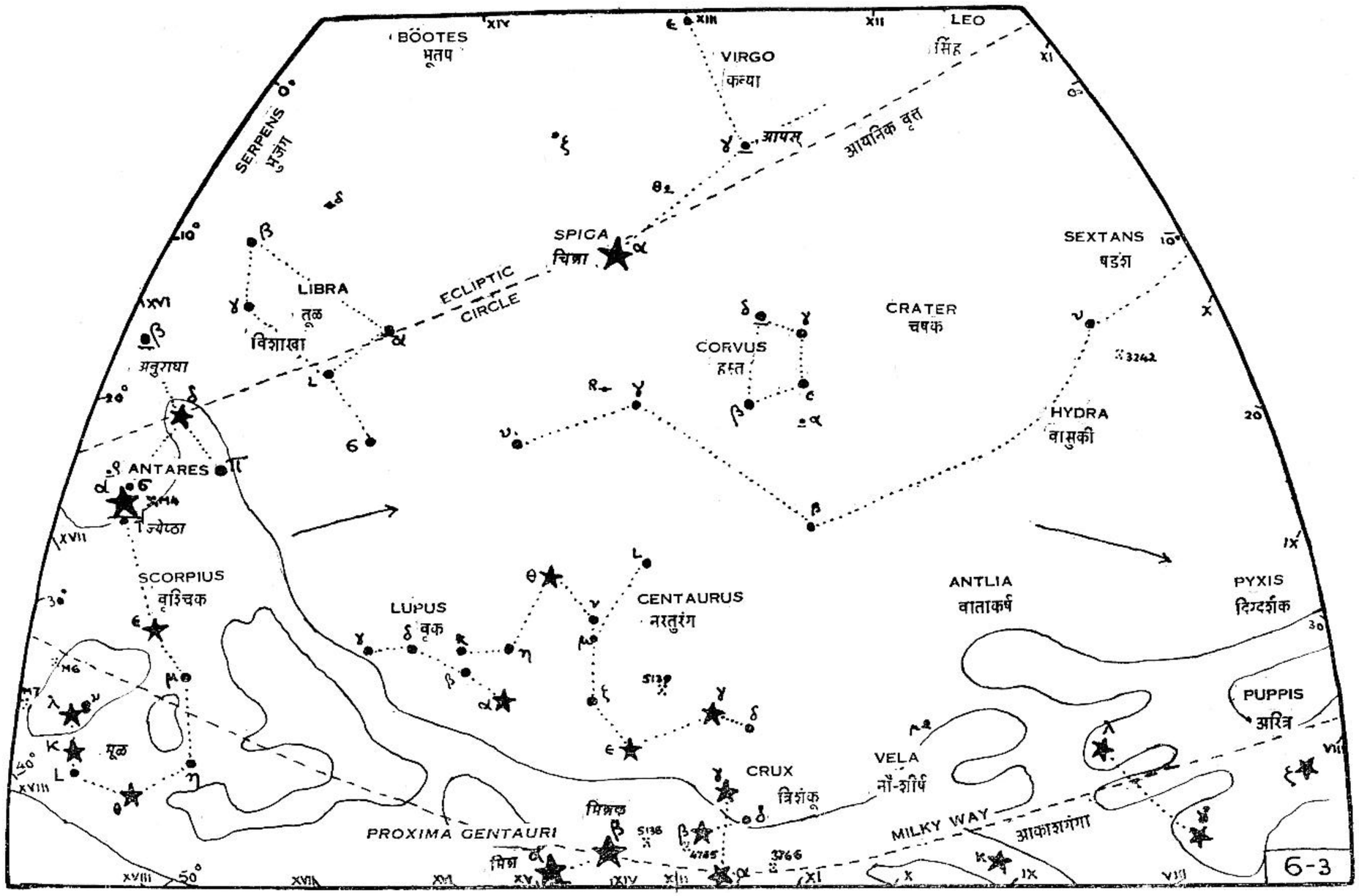


Observer's Latitude : 25° N

JUNE
SOUTH
KEY - MAP

February	1	at	5	a. m. (I. S. T.)
March	1	at	3	a. m.
May	1	at	11	p. m.
June	**1**	**at**	**9**	**p. m.**
July	1	at	7	p. m.

February	15	at	4	a. m. (I. S. T.)
March	15	at	2	a. m.
May	15	at	10	p. m.
June	**15**	**at**	**8**	**p. m.**
July	15	at	6	p. m.

JUNE : SOUTHERN SKY

Prominent Stars :

- α in Centaurus (Al Kentaurus), second nearest star.
- β in Centaurus in line with the cross-arm of Crux.
- α in Crux or Southern Cross.
- β in Leo (Denebola).
- α in Libra (Zuben el Genuti) lies exactly on the Ecliptic.
- α in Scorpius (Antares)
- α in Virgo (Spica) lies exactly on the Ecliptic.

Double Stars :

- α in Centaurus, splendid binary, companions of 0.3 and 1.7 magnitudes.
- δ in Corvus, main star is yellow, components of magnitudes 3.0 and 8.5
- α in Crux. Pair of magnitudes 1.4 and 1.9. Seen with a 2.5 cm. telescope.
- α in Libra, wide double 230″ apart.
- μ in Vela, magnitudes 3.0 and 6.8, fine contrast in colours.
- γ in Virgo, 2 equally bright components seen with a 5 cm. telescope.
- α in Scorpius with faint companion. Components red and green.
- β ν, ρ in Scorpius, these are wide doubles.
- ξ in Scorpius seen with a 5 cm. telescope.
- ν in Scorpius has a companion and each is a double.

Variable Stars :

- τ in Centaurus, long period of 90 days. Variation from 5.2 to 10 magnitudes.
- δ in Libra, Algol type, varies from 4.8 to 6.2 magnitudes.

Nebulae and Star Clusters :

NGC 3766 in Centaurus, about 200 individual stars, sight for naked eyes.

NGC 5139 in Centaurus, globular, seen with naked eyes.

NGC 4755, surrounding star K, in Crux near β. Over 100 coloured stars like a box of jewels.

NGC 6067 in Norma, near Lat. 59°.5 S. rich cluster 20′ in diam.

M 4 (NGC 6121) in Scorpius near Antares, bright and globular.

M 7 (NGC 6475) in Scorpius, brilliant open cluster, seen with naked eyes.

* * *

Occultation

TO OCCULT means to cut off from view, by passing in front of something. Occultation takes place when the Moon or a planet, in its orbit, passes between the observer and another celestial body, and hides the latter. The occulting body is usually the Moon because of its large apparent diameter. In this case, the disappearance of a star or planet occurs at the east side of the Moon, and the reappearance at the west. The Occultation of Jupitor's moons can be observed as they pass behind the planet. Observations of Occultations are used to determine the motion of the moon and the planets with ever-increasing accuracy. Moreover, the light variation of the star during the Occultation enables deductions to be made concerning the atmosphere of the occulting body.

* * *

Observer's Latitude : 25° N.

February	1	at	5	a. m. (I. S. T.)
March	1	at	4	a. m.
May	1	at	11	p. m.
June	**1**	**at**	**9**	**p. m.**
July	1	at	7	p. m.

JUNE
WEST
NIGHT-SKY

February	15	at	4	a. m. (I S. T.).
March	15	at	2	a. m.
May	15	at	10	p. m.
June	**15**	**at**	**8**	**p. m.**
July	15	at	6	p. m.

Leo and Leo Minor

AMONG THE different pictorial representations of the star groups that we see in the night-sky, those of Leo (The Lion) and Scorpius (the Scorpion) appear to be the most appropriate.

Leo is the name given to one of the twelve parts of the regions in the vicinity of the Sun's path among the stars. This path is called the Ecliptic, and the twelve divisions are called Zodiacal Signs. The origin of the names for all these signs dates from the times of the Chaldeans. The Greeks took the names from the Chaldeans and adopted them to suit legends from Greek mythology. Some names were altered in this process, but the name Leo remained the same. Indian names are almost identical with the Greek names.

According to Greek mythology, Leo was the celebrated Nemean Lion which was killed by Hercules as the first of the Twelve Tasks, assigned to him by his cousin Eurytheus. The legend is significant because it used to be the hot season in Greece when the Sun entered the constellation Leo in its annual movement through the Ecliptic.

The group of stars comprising Leo look like a sickle and they form the head of the lion. The right-angled triangle of three stars, including the bright star Denebola, forms the rear portion of the lion.

The stars α, γ, ζ, η, ε, and μ together make the figure of a sickle. The brightest star in this, namely α, is called Regulus and it goes to make the handle while the others make up the blade. β or Denebola forms the tail of the lion.

In ancient times, the Egyptians used to worship the stars in Leo because at this time the Sun used to enter the constellation, causing floods in the river Nile and inducing a bumper harvest.

In Vedic times, the Vernal equinox used to coincide with the Pleiades (η of Taurus) and the rainy season commenced when the Sun reached Leo. There is a reference in the Upaniṣada that the reckoning of the year, in those ancient times, began with *Maghā* (मघा) namely Regulus.

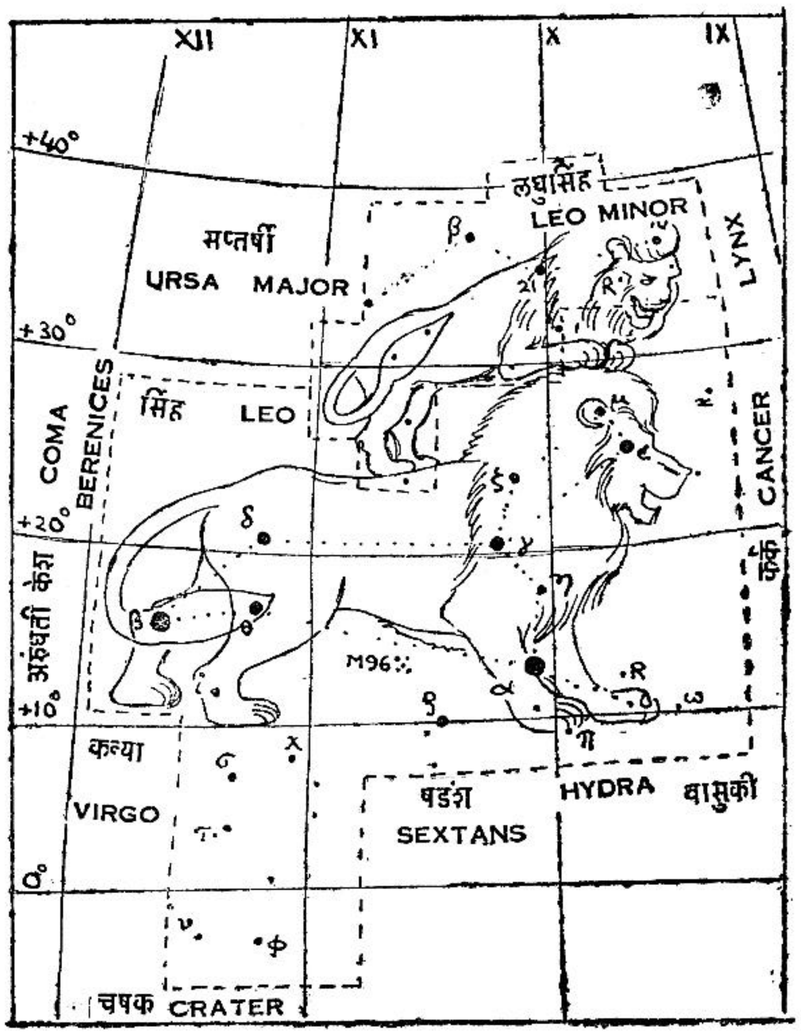
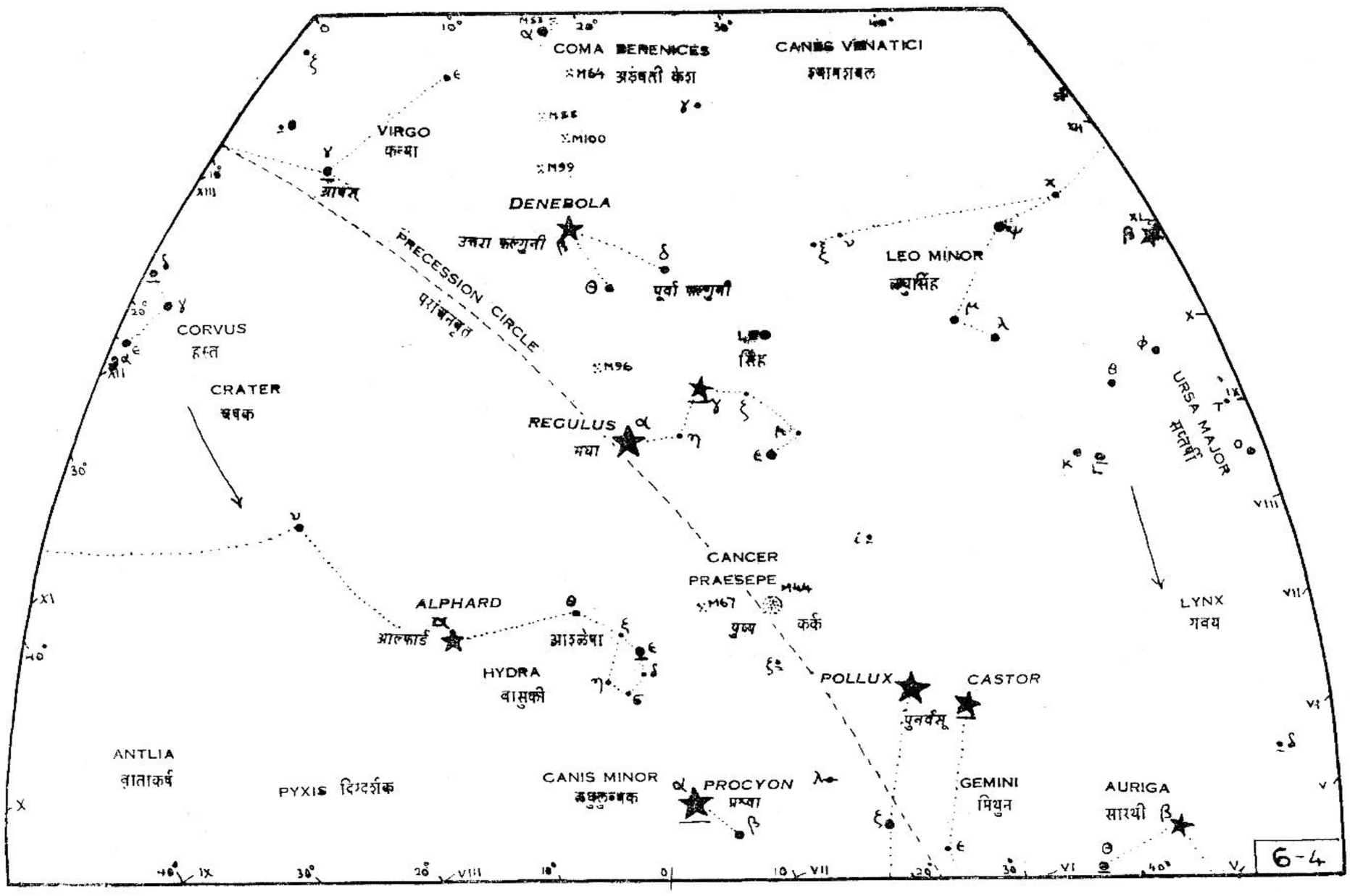


Fig. 6.4 : Leo, Leo Minor

About the year 3000 B. C., the Persians considered Regulus as one of the four Royal Stars marking the Summer Solstice.

(Continued on page 129 column 2).



Observer's Latitude : 25° N

JUNE
WEST
KEY - MAP

February	1	at 5	a. m. (I. S. T.)
March	1	at 3	a. m.
May	1	at 11	p. m.
June	**1**	**at 9**	**p. m.**
July	1	at 7	p. m.

February	15	at 4	a. m. (I. S. T.)
March	15	at 2	a. m.
May	15	at 10	p. m.
June	**15**	**at 8**	**p. m.**
July	15	at 6	p. m.

JUNE : WESTERN SKY

Prominent Stars :

α in Canis Minor (Procyon).
α, β in Gemini (Castor and Pollux).
α in Hydra (Alphard).
α in Leo (Regulus).
β in Leo (Denebola).
α in Virgo (Spica).

Double Stars :

i in Cancer, seen with field glasses.
ζ in Cancer, This is a triplet and famous.
α in Gemini is sextuple.
λ in Gemini, seen with a 7.5 cm. telescope.
δ in Gemini, seen with a 5 cm telescope.
θ in Hydra, of magnitudes 5.0, 10.8, seen with 7.5 cm. telescope.
γ in Leo, seen with a 5 cm telescope.
γ in Virgo, equally bright components seen with 5 cm. telescope.

Variable Stars :

ζ, η in Gemini, with periods of 10.2 and 231 days.
R in Hydra, Mira type variable, with a period of 442 days.

Nebulae and Star Clusters :

M 44 (NGC 2632) or " Praesepe " in Cancer near δ, seen with naked eyes. Best seen with a low power field telescope.
M 67 (NGC 2682) in Cancer near α, open cluster, seen in a field glass.
M 53 (NGC 5024) in Coma Berenices, above star 42, globular and seen with field glasses.
M 100 (NGC 4321) in Coma Berenices, south of star 11. seen with field glasses.
M 35 (NGC 2168) in Gemini, above μ and η, seen with naked eyes.
M 96 (NGC 3368) in Leo between α and β. Spiral nebula seen with field glasses.

* * *

(Continued from page 127 column 2).

Leo and Leo Minor

In Indian astronomy, the name for Regulus is Maghā. (मघा). It is a double star and it lies on the Ecliptic. The main star is white and the companion is blue. The distance of Regulus from us is about 35 light years and it is receding at the rate of about 24 Km. per second. It is considered to be of the same stellar type as Sirius.

Between α and β of Leo, a spiral nebula M 96 can be seen with a field glass. Star δ as is called Zoska.

The most attractive occurrence in Leo is the Meteoric showers that start from a point in the neighbourhood of γ. These showers are, therefore, called Leonids and they occur profusely from the 9th. to 17th. November, with a maximum on 13th. or 14th. Every 33 years they offer a rich spectacle. The last shower was in 1965.

Leo Minor

THIS NOMENCLATURE is comparatively new and it means the Cub of a Lion. The constellation is made up of a group of stars to the north of Leo. Star Denebola is often included in this constellation. There are 3 stars of magnitude 4.5.

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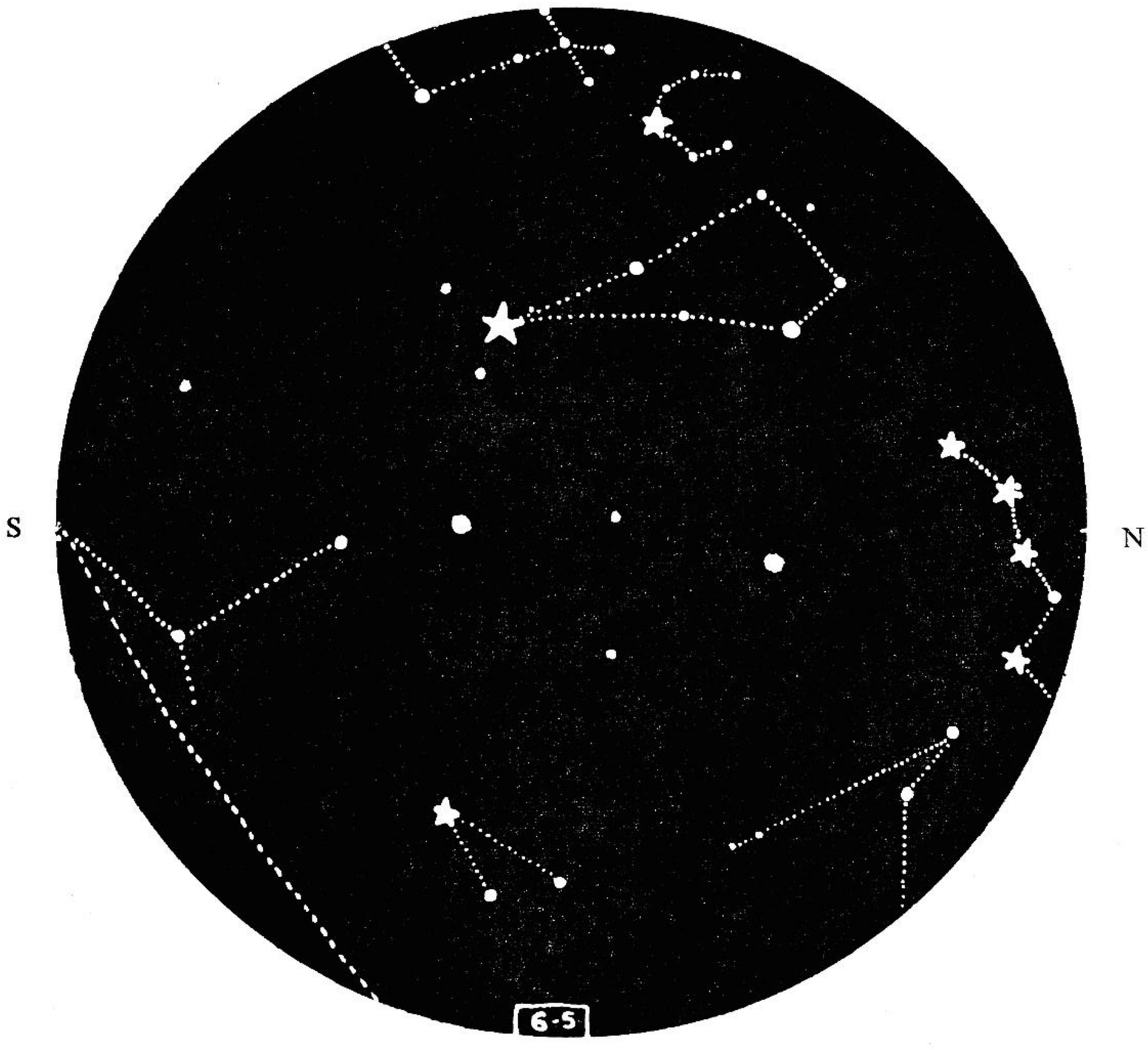

Observer's Latitude : 25° N

JUNE
ZENITH
NIGHT-SKY

February	1	at	5	a. m. (I. S. T.)	February	15	at	4	a. m. (I. S. T.)
March	1	at	3	a. m.	March	15	at	2	a. m.
May	1	at	11	p. m.	May	15	at	10	p. m.
June	**1**	**at**	**9**	**p. m.**	**June**	**15**	**at**	**8**	**p. m.**
July	1	at	7	p. m.	July	15	at	6	p. m.

Stellar Temperatures

SUNLIGHT APPEARS white, but with the help of a prism it can be resolved into a band of separate colours, properly called the spectral colours. These colours are red, orange, yellow, green, blue, indigo and violet. With the help of improved instruments and technique, it is possible to analyse light still further. These instruments are called spectroscopes or spectrometers accordirg to the purpose they are desired to serve. Spectrographs take photographs of the spectral distribution of light, leading to the measurements of the wave-lengths of light in the different parts of the spectrum. Spectrometers employ a photo-cell and measure the intensity of light in the different parts of the spectrum.

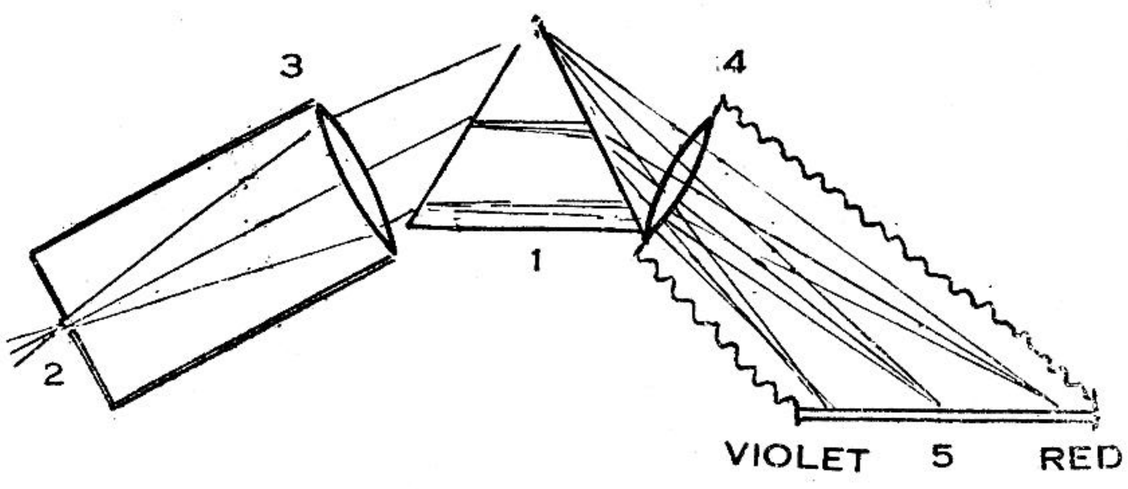

Fig. 6.5. : Principle of a Spectroscope : 1 Prism, 2 Slit, 3 Collimeter, 4 Lens (Camera) 5 Image of Spectrum

When a chemical element emits light, its spectrum contains certain lines and these are peculiar to that element. Whenever the spectrum of light from a glowing object is examined, that spectrum contains all the lines of the different chemicals elements that go to make up the source that emits the light. These lines are called Emission lines and they appear bright. The spectrum of solar light, however, consists of a great number of dark lines across the bands of colours. These lines are called Fraunhofer lines. These lines correspond to the bright, emission lines, but they are black because they are the result of absorption. (In this connection see Fig. 5.5 on Page 105).

It is common knowledge that a substance placed inside a furnace changes its colour from red to white with the rising temperature. When gases are able to give emission spectra, their spectra indicate the state of temperature that causes the emission. Considerable amount of work in this direction has led to the establishment of certain rules known as Radiation Laws. With the help of these rules, it is now possible to estimate the surface temperatures of the Sun and the stars. A large number of stars have been examined in this manner and classified according to their surface temperatures. The accompanying table gives the name of the spectral type, the approximate temperature, its colour, character and the name of the representative star.

Classification of Stars

Spectral Type	*Temperature °C*	*Colour*	*Character*	*Representative Star*
O	Over 32,000	blue-white	strongly ionised gases	iota in Orionis
B	20,000	blue-white	strong neutral helium	Rigel, Spica
A	11,000	white	Hydrogen predominant	Sirius, Vega
F	7,500	yellowish white	Hydrogen decreasing, metals increasing	Canopus, Procyon
G	6,000	yellow	Metals prominent	Sun, Capella
K	4,500	orange	Metals surpass Hydrogen	Arcturus Aldebaran,
M	3,000	red	Titanium oxide present	Betelgeuse, Antares

These are only surface temperatures. The temperatures in the interior of the star can be several million degrees as estimated from the kinds of Nuclear Reactions going on there.

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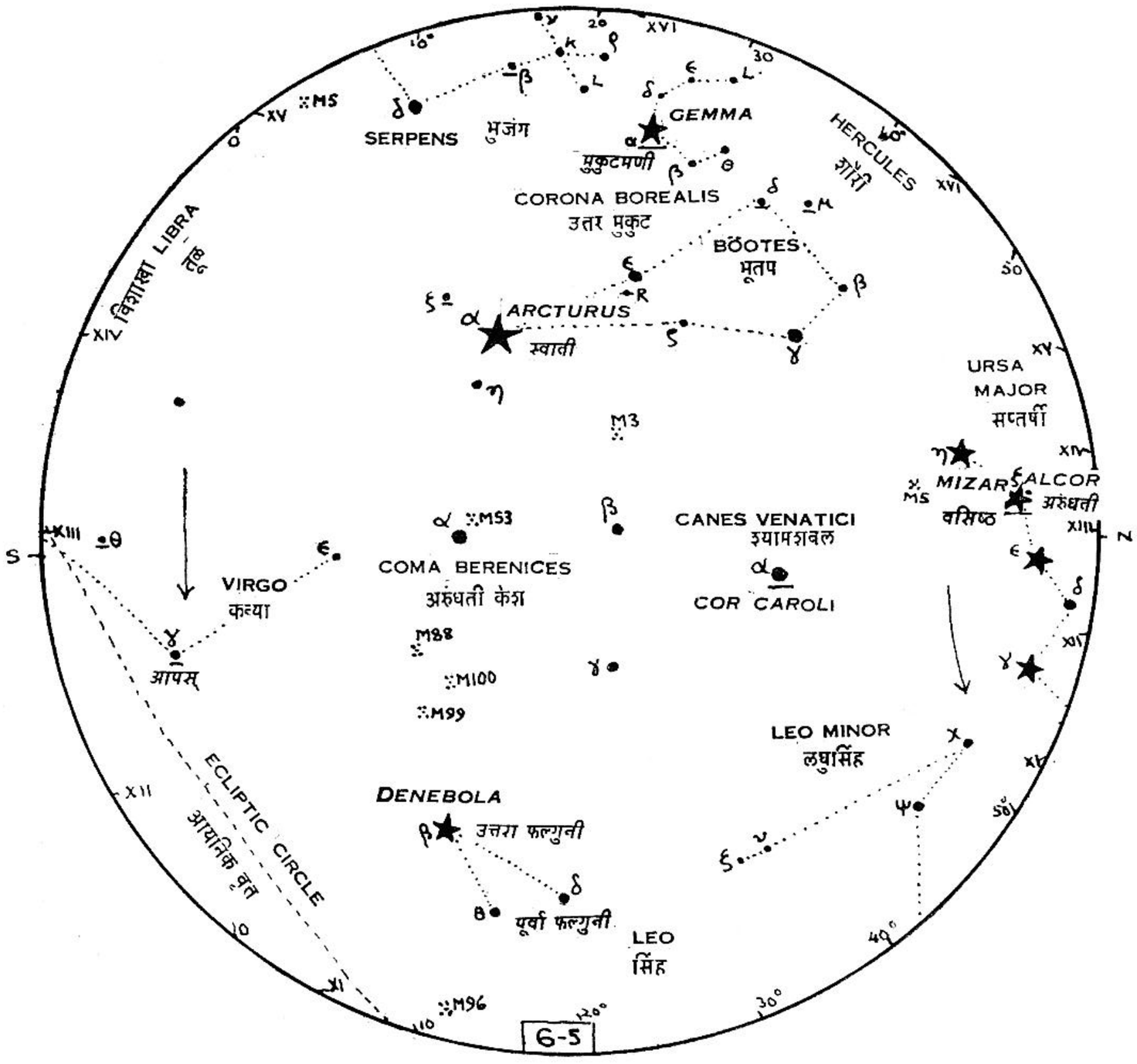

Observer's Latitude : 25°N

JUNE ZENITH KEY–MAP

February	1 at 9 a. m. (I. S. T.)	February	15 at 4 a. m. (I. S. T.)
March	1 at 3 a. m.	March	15 at 2 a. m.
May	1 at 11 p. m.	May	15 at 10 p. m.
June	**1 at 9 p. m.**	**June**	**15 at 8 p. m.**
July	1 at 7 p. m.	July	15 at 6 p. m.

Evolution of the Universe

THE UNIVERSE comprises the entire creation, the earth and other planetary members of the system with the Sun as its head, the stars, which are really large and small suns, the Milky Way which forms our stellar system. It also contains numerous other galaxies, stellar systems separated from ours and from each other by vast tracts of empty space.

It is somewhat difficult to appreciate the immense nature of the Universe. With the 500 cm. telescope and the modern powerful radio telescopes, we can observe only a part of the Universe. What remains yet hidden from us is really not known to us and we cannot even make any guesswork in that direction. The Milky Way, our galaxy, contains about 100,000 million stars. But one must remember that there are also hundreds of millions of other galaxies.

There are two distinct points of view about the origin of the Universe. (1) According to one view, it is assumed that the present state of the Universe is the result of a continuous evolutionary process started a few thousand million years ago. This view takes it for granted that *the Universe had a beginning*. (2) According to the other viewpoint, the Universe, as it exists to day, has been so existing for all time. This view takes it for granted that the Universe had no beginning and it will have no end. It assumes that the *Universe is in a steady state*.

Our present notions about the origin of the Universe, indeed the origin of all matter, are based on the collective knowledge obtained from scientific discoveries. We know now, for instance, that like our galaxy there are many more independent galaxies in the space. We also know that these galaxies are moving away from us and from each other at great speed. This extraordinary information that the Universe is expanding provides a key to the main problem concerning the birth of the Universe.

It is considered, for instance, that all matter which we now find scattered in the vast empty space of the universe might have been, at some time, compressed or squeezed into a very small space. This was, indeed the situation *before* any of the stellar bodies were born.

A consideration like the above naturally raises two new questions. (1) Why was the Universe in a squeezed state ? (2) What caused its expansion at some later state ?

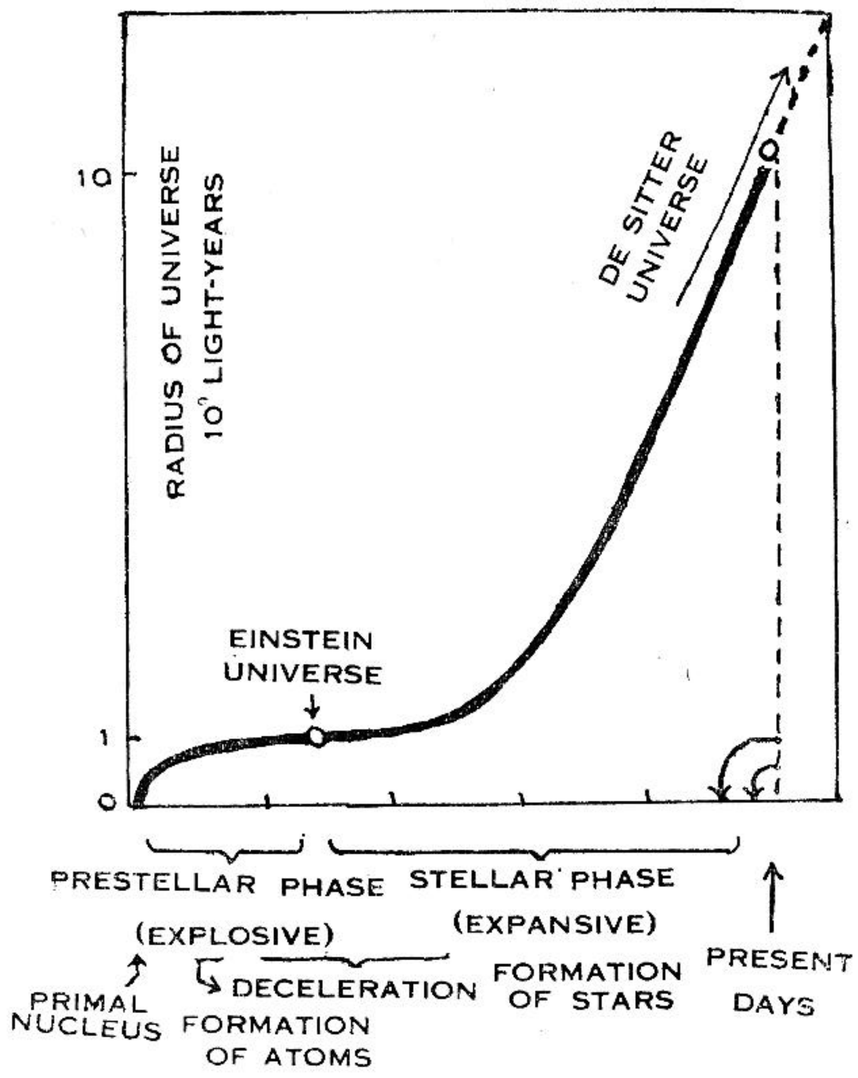

Fig. 6.5 : Different stages in the Evolution of the Universe.

There are no final answers to any of these questions yet. But one can make several guesses. It is probable that the Big Squeeze in the early history of the Universe was the result of a collapse which must

(Continued on page 137 column 2)

Observer's Laittude : 25° N

JULY
NORTH
NIGHT-SKY

March	1 at 5 a. m. (I. S. T.)	March	15 at 4 a. m. (I. S. T.)
April	1 at 3 a. m.	April	15 at 2 a. m.
June	1 at 11 p. m.	June	15 at 10 p. m.
July	**1 at 9 p. .m.**	**July**	**15 at 8 p. m.**
August	1 at 7 p. m.	August	15 at 6 p. m.

Draco

THIS IS an important constellation of the Northern Hemisphere and it is situated between the two Bears, Ursa Major and Ursa Minor. It represents a huge dragon winding its way half-way round the celestial axix and having its head almost halfway between the bright star Vega (α of Lyra) and the constellation Ursa Minor (the Little Bear).

According to Christian mythology, Draco is the snake that is known to have tempted Eve.

In yet another legend, this is the dragon which had placed himself across the path leading to the tree where the Golden Fleece was kept fastened. It is said that Orpheus drugged the snake with music and Jason stepped over its huge coils to snatch the Golden Fleece from the tree. The Fleece belonged to the wonderful Ram and Jason was a member of the Argonatic Expedition.** The legend ends with the statement that both the Ram and and the Snake were placed among the stars, as consellations Aries and Draco.

There is another mythological legend about Draco. During the great war between the Gods and the Demons, a big snake-like monster tried to interfere. Goddess Minerva caught him and threw him into the heavens where it got caught on the axis of the Universe and could not make its escape.

The constellation Draco is important on account of the fact that its brightest star α, known as Thuban, was regarded by the Egyptians as the Pole Star about the year 2700 B. C. Poles are points where the celestial axis meets the celestial sphere. Pole Star is the name given to that particular bright star which happens to be as near as possible to the celestial axis, in the northern hemisphere. When the great pyramid of Cheops in Egypt was built about 4600 years ago, the bright star α of Draco was only 10′ away from the exact Pole.

The Latitude of Cheops is 30°N. In the pyramid there was a narrow passage, built in, which was directed towards the star Thuban. The passage was so constructed that the light from Thuban, the Pole Star, could fall, both by day and by night, on the idol kept at the lower end of the passage inside the temple pyramid. Owing to the precessional motion of the celestial axis light from Thuban, at the present time, does not go through the narrow opening but it will do so again after about 21,000 years if the great pyramid continues to be there. Different stars come near the celestial axis from time to time due to precessional motion.

In the *Upaniṣad* (उपनिषद्), there is a reference to this same star Thuban as the Pole Star and thus a reliable clue is obtained as regards the time when the Vedic texts were composed.

Stars β and γ are of magnitudes 2.9 and 2.4 respectively. They are called Alwaid (Ṛta ऋत) and Etamin (Satya सत्य) and they correspond to the two shining eyes of the dragon.

Star γ is a double, consisting of two equally bright companions of mangitude 5.

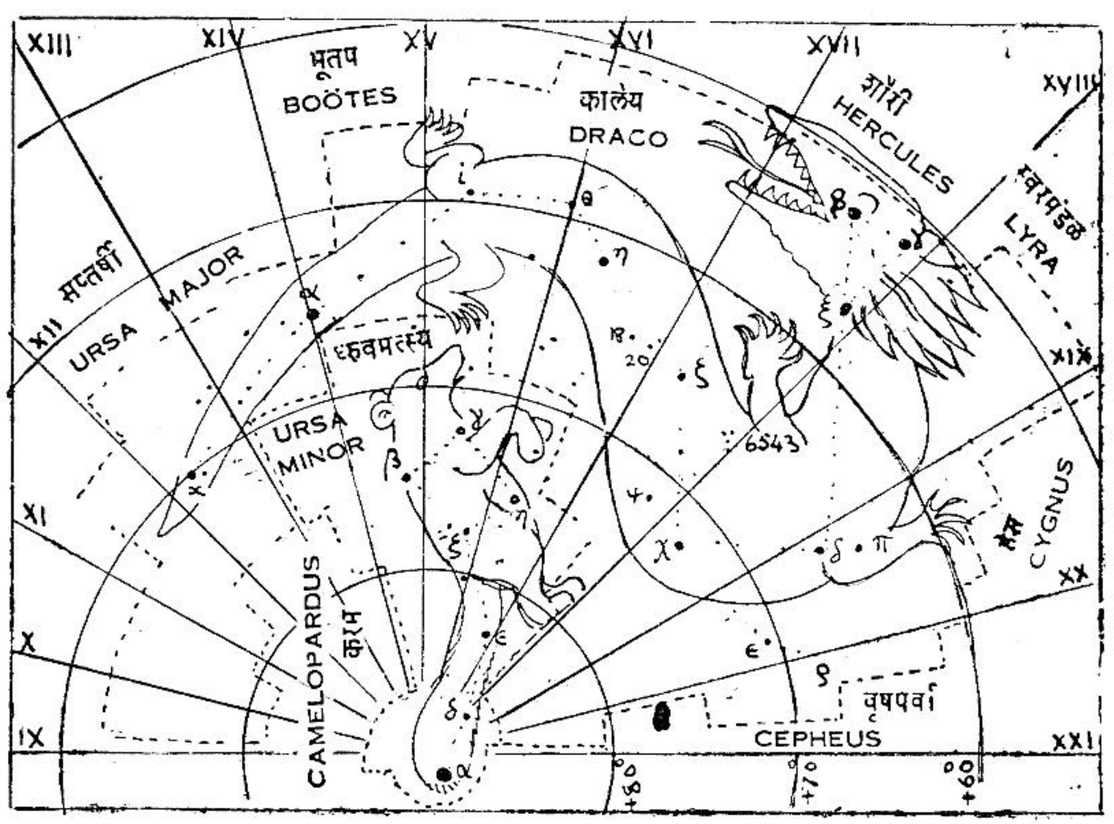

Fig. 7.1 : Draco

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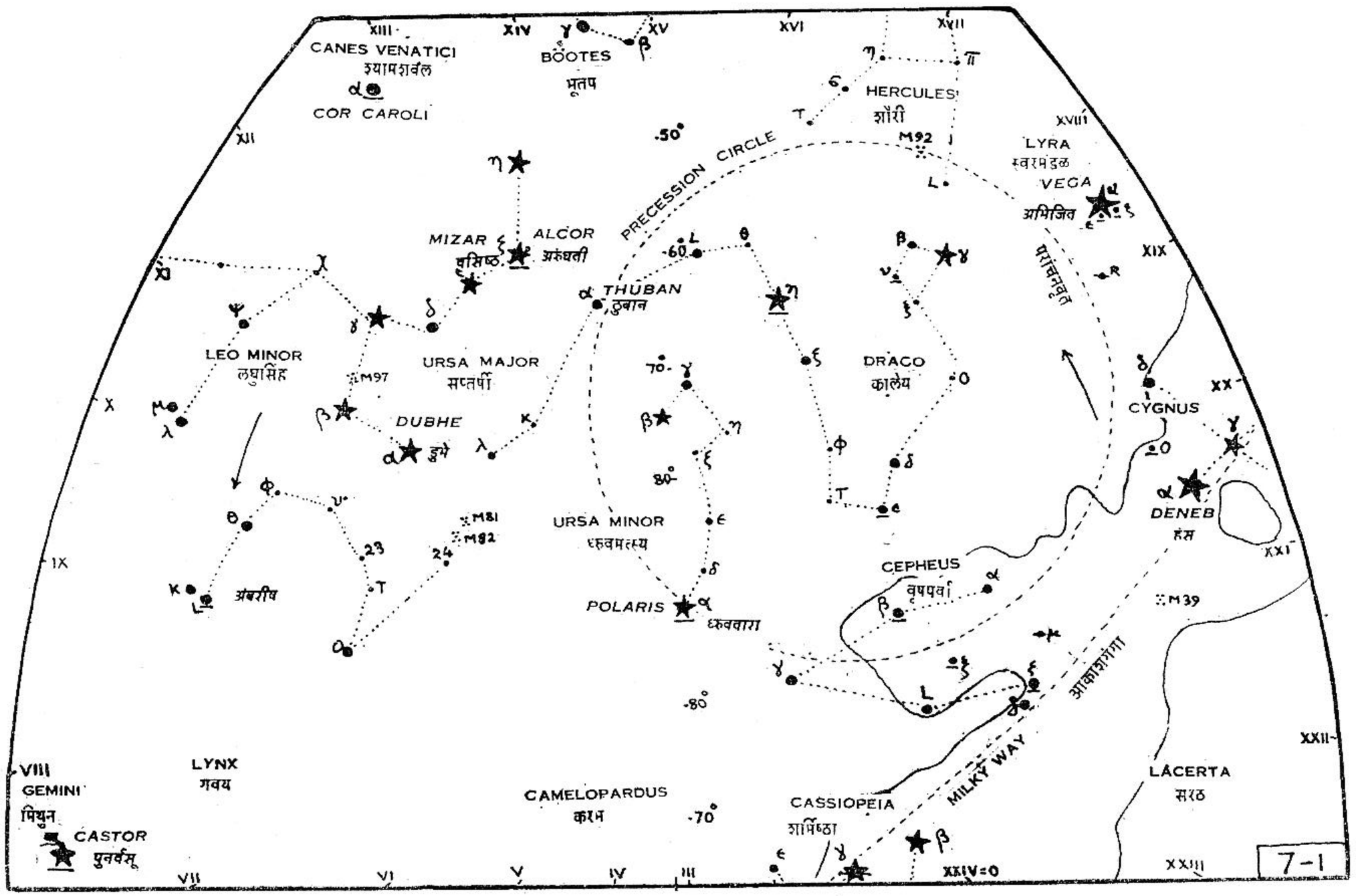
* See *Hercules* at Page 99

* * *Argonautic expedition* at Page 63



Observer's Latitude : 25° N

JULY
NORTH
KEY - MAP

March	1 at 5 a. m. (I. S. T.)	March	15 at 4 a. m. (I. S. T.)
April	1 at 3 a. m.	April	15 at 2 a. m.
June	1 at 11 p. m.	June	15 at 10 p. m.
July	**1 at 9 p. m.**	**July**	**15 at 8 p. m.**
August	1 at 7 p. m.	August	15 at 6 p. m.

JULY : NORTHERN SKY

Prominent Stars :

α in Canes Venatici (Cor Caroli).

α in Cygnus (Deneb),

α in Draco (Thuban); former Pole Star,

α in Hercules (Ras Alghetti),

α in Lyra (Vega), future Pole Star,

α, β in Ursa Major (The Pointers),

ζ in Ursa Major (Mizar) with its neighbour Alcor,

α in Ursa Minor (Polaris), present Pole Star,

Double Stars :

α in Canes Venatici, and seen with a 5 cm. telescope.

β, ξ in Cepheus, seen with a 5 cm. telescope.

ν in Draco, equally bright stars, seen with binoculars.

ε, η in Draco seen with a 7.5 or 10 cm. telescope.

ζ in Ursa Major, companion Alcor 11″ away, seen with naked eyes. ζ is itself a double. Seen with a 5 cm. telescope.

α in Ursa Minor, wide double seen with a 5 cm. telescope.

Variable Stars :

α in Hercules, varies from magnitude 3.1 to 3.9

δ in Cepheus, representative variable, period of 5.37 days.

Nebulae and Star Clusters :

M 3 (NGC 5272) in Canes Venatici, under star 25, open brilliant cluster seen with naked eyes.

M 39 (NGC 7092) in Cygnus, beyond α and near π^2. Open cluster seen with a field glass.

There is in Cygnus a very strong source of radio emission.

M 13 (NGC 6205) in Hercules, between η and ζ seen with naked eyes.

M 92 (NGC 6341) in Hercules, beyond π in line with α, δ, π, seen with naked eyes.

M 57 (NGC 6720) Ring Nebula in Lyra, about half-way on the line connecting β and γ. Seen through a telescope.

* * *

(Continued from page 133 column 2)

Evolution of the Universe

have occurred at some still earlier time. It is also probable that the present state of expansion is the result of an elastic rebound after maximum squeezing was reached.

The theory of the Expanding Universe was advanced and supported by W. de Sitter (1917), A. Friedmann (1922) and G. Le Maitre (1927)

The theory of the Steady State of the Universe was based on the continuous creation of matter to take the place of the matter lost by radiation. According to this theory, which is supported by H. Bondi, T. Gold and Fred Hoyle (1948), the general state of the Universe remains the same for all time. Newly created matter fills the gap created by receding galaxies. According to this theory both space and time are infinite, having no beginning and no end.

Observations with more powerful telescopes, optical and radio, are being made and new information is being collected. There are also big advances made in theoretical science. All this would eventually assist us in obtaining more accurate knowledge regarding the evolution of the universe.

* * *

Observer's Latitude : 25° N

JULY
EAST
NIGHT - SKY

March	1 at 5 a. m. (I. S. T)
April	1 at 3 p. m.
June	1 at 11 p. m.
July	**1 at 9 p. m.**
August	1 at 7 p. m.

March	15 at 4 a. m. (I. S. T.)
April	15 at 2 a. m.
June	15 at 10 p. m.
July	**15 at 8 p. m.**
August	15 at 6 p. m.

Ophiuchus and Serpens

THESE ARE two separate constellations, but in the pictorial maps, they are shown as quite mixed up with each other, becauses Ophiuchus, the Serpent Bearer, is holding the coils of the large Snake (Serpens) in both his hands.

The constellation Ophiuchus is to the north of Scorpius. The Babylonians considered Ophiuchus as a warrior. He is shown as turned towards the Scorpion after having crushed under his feet the two snakes, Hydra and Serpens.

According to Greek mythology, Ophiuchus perpetuates the memory of Aesculapius, the father of medicine. He was medical officer with the Argonautic Expedition. He was very much respected by men on earth and by Gods in heaven. Men erected temples in his honour and Gods placed him (Ophiuchus) among the constellations.

Hercules* and Ophiuchus cover a very large part of the sky in the northern hemisphere but none of them has any very bright stars. Hercules appears to be inactive, at least after his Labours, kneeling on Draco. Ophiuchus appears to be still struggling with the coils of the serpent. The heads of the two warriors are near each other. The bright star in Ophiuchus is α (Ras al Haque) and it is shown on the brow of the warrior. The other neighbouring bright star is α of Hercules or Ras al Ghetti and it is shown on the brow of that warrior. These two stars are separated from each other by approximately the same distance, about 5°, as that between the Pointers (α, β of Ursa Major).

The constellation Serpens cannot be isolated from Ophiuchus. There are 3 double stars in the serpent's tail, but the star θ (tail star) can be observed with field glasses.

The star-names are β (Kal al Rai), δ (Yed) and ζ (Sabik).

Star Cluster M 5 is near α (Unulk al haq) of Serpens; it is very bright and visible to the naked eyes.

* See *Hercules* at page 99

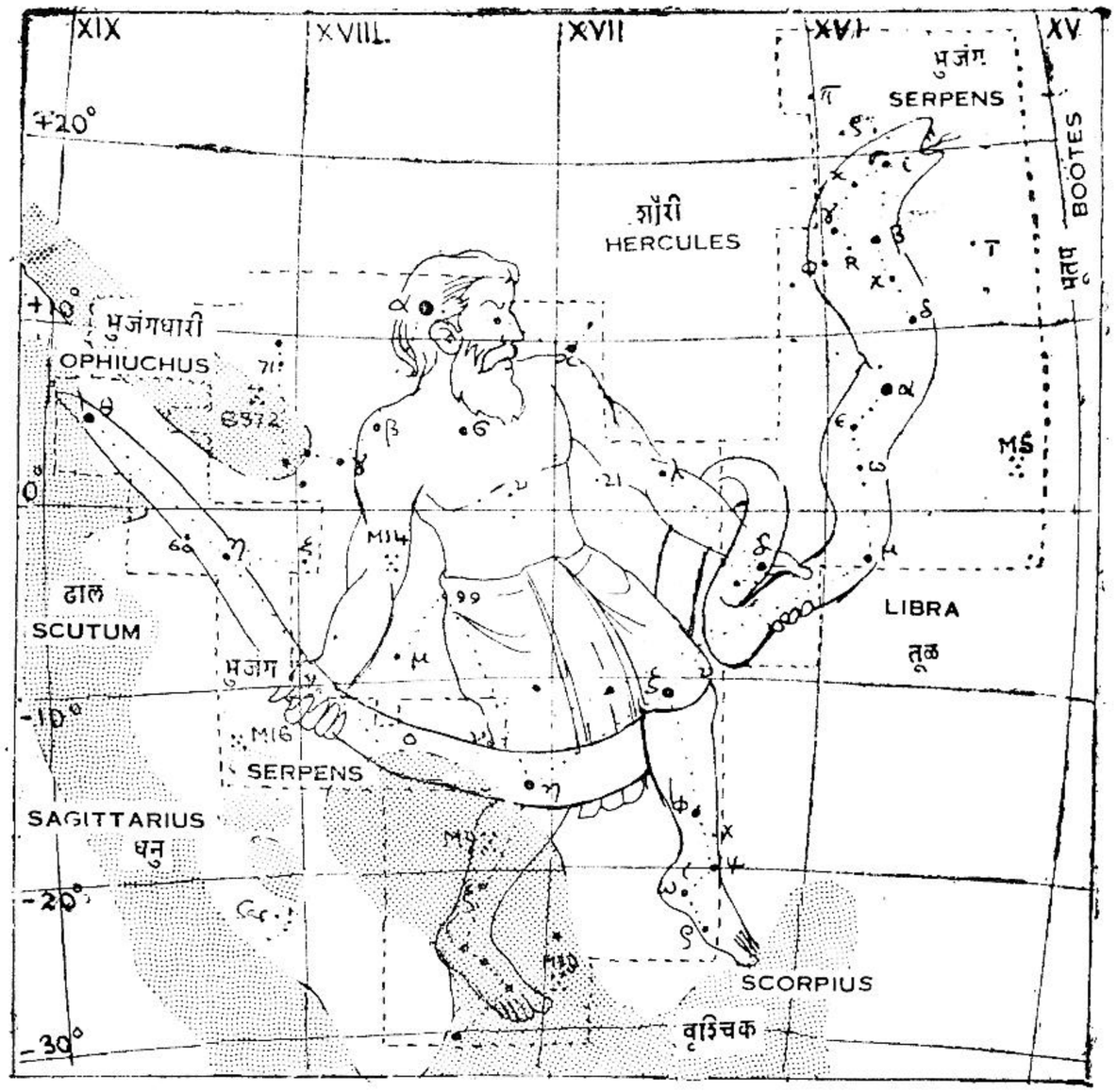


Fig. 7.2 : Ophiuchus and Serpens

Star No. 70, between η of Serpens and β of Ophiuchus is double and easily visible through a 5 cm. telescope. Its components are red and yellow.

There are many star clusters in this constellation. Near the feet of Ophiuchus, there appears to be a gap in the Milky Way and it is believed that this is due to the presence of a dark nebula at a distance of about 400 light-years from us.

Star clusters are M 10, M 12 and M 19. Another cluster NGC 6633 near θ of Serpens is visible through a binocular.

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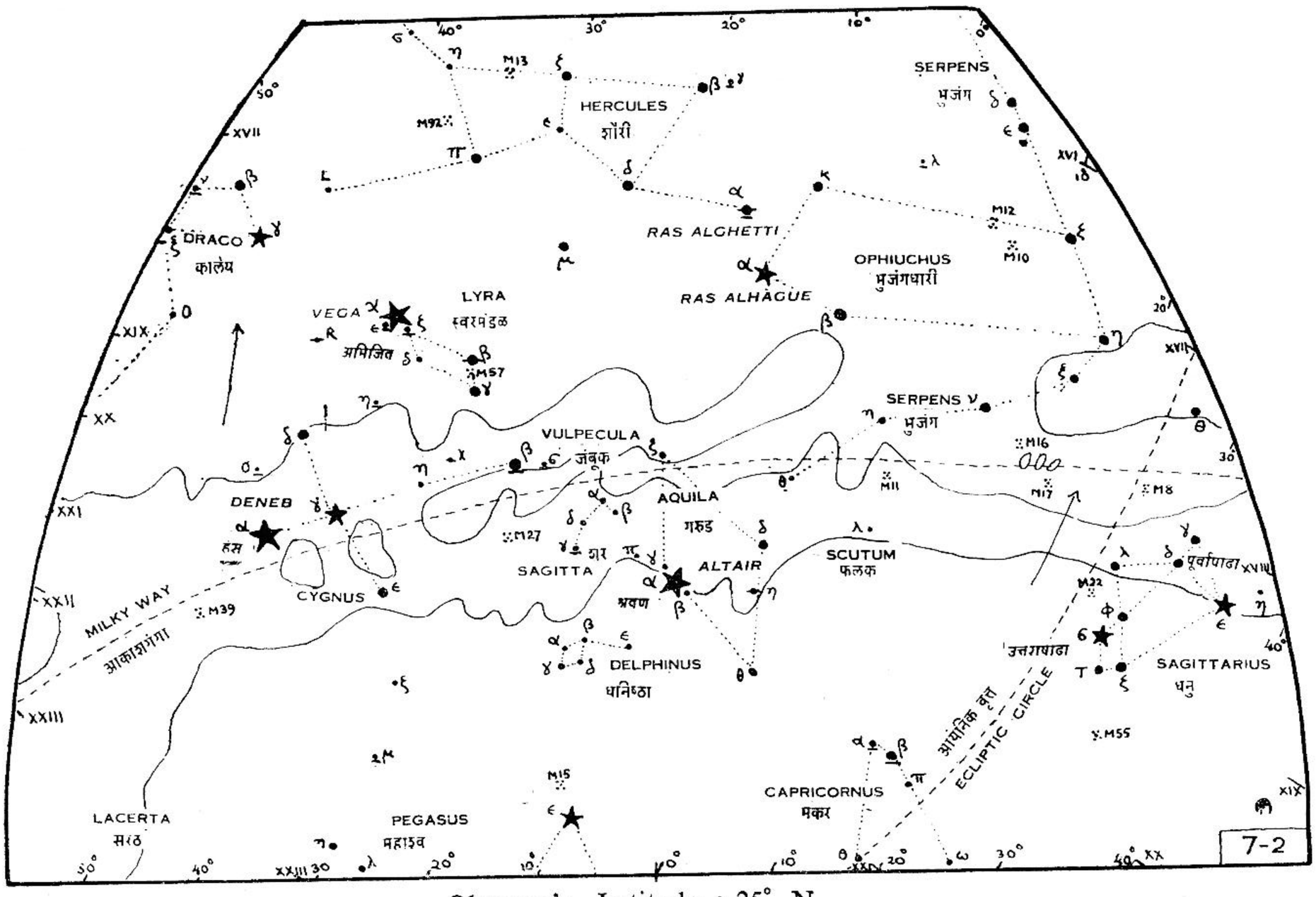

Observer's Latitude : 25° N

March	1 at 5 a. m. (I. S 'T.)
April	1 at 3 p. m.
June	1 at 11 p. m.
July	**1 at 9 p. m.**
August	1 at 7 p. m.

JULY
EAST
KEY-MAP

March	15 at 4 a. m. (I. S. T.)
April	15 at 2 a. m.
June	15 at 10 p. m.
July	**15 at 8 p. m.**
August	15 at 6 p. m.

JULY : EASTERN SKY

Prominent Stars :

α in Aquila (Altair).

α in Cygnus (Deneb).

α in Hercules (Ras al Ghetti).

α in Lyra (Vega).

α in Ophiuchus (Ras al Haque).

Double Stars :

π in Aquila seen with a 7.5 cm. telescope.

β in Cygnus seen with field glasses; brighter component is orange, fainter is blue.

γ in Delphinus, yellow and emerald, seen with a 5 cm. telescope.

α in Hercules, with blue companion, distance 4.6″ apart.

α in Lyra, optical pair, 0.2 and 10.5 magnitudes.

ε in Lyra, wide double 208″ apart, seen with naked eyes.

ζ, β in Lyra, wide pairs, seen through a binocular.

η in Lyra, 3 small pairs seen in a low power field-glass.

Star 70 in Ophiuchus, between η of Serpens and β of Ophiuchus, yellow and red components, seen with a 5 cm telescope.

θ in Serpens, seen with a field-glass.

Special Sight

δ, μ, ρ, γ in Hercules are rewarding objects seen through a 5 cm. telescope.

Variable Stars

η in Aquila, Cepheid type, period of 7.18 days,

α in Hercules, variation from 3.1 to 3.9 magnitudes.

Nebulae and Star Clusters

M 13 (NGC 6205) in Hercules between η and ζ; seen with naked eyes.

M 92 (NGC 6341) in Hercules, beyond π, in line with α, δ, π, seen with naked eyes.

M 57 (NGC 6720) in Lyra, Ring Nebula, about halfway on the line connecting β and γ; seen only with a telescope.

M 22 (NGC 6656) in Sagittarius, between μ and σ. Large and bright.

M 8 (NGC 6523) in Sagittarius, gaseous nebula, seen with naked eyes.

M 10 (NGC 6254), M 12 (NGC 6218) in Serpens, on the line β δ of Ophiuchus,

NGC 6633 in Serpens, near θ, seen with a field-glass.

M 27 (NGC 6853) in Vulpecula. Planetary Nebula seen only through a 25 cm. telescope.

* * *

Astrolabe

THIS IS a kind of oldest astronomical instrument. It was used by the ancient Greeks, and it remained the chief measuring instrument until recent times. In its simplest form, the Astrolabe consists of a graduated disc and a movable ruler, the alidade. Alidad is an index on a quadrant showing degrees cut off on arc. If it was desired to measure an apparent angular distance on the celestial sphere between stars, say A and B, the instrument was held with the disc in the plane of the observer's eye and the two stars. If the ruler was aimed in the direction of A and then in that of B, the difference between the two readings gave the angle AOB, that is, the angular distance in degrees of arc between A′ and B′ on the celestial sphere.

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Observer's Latitude : 25° N

JULY
SOUTH
NIGHT-SKY

March	1 at 5 a. m. (I. S. T.)
April	1 at 3 a. m.
June	1 at 11 p. m.
July	**1 at 9 p. m.**
August	1 at 7 p. m.

March	15 at 4 a. m. (I. S. T.)
April	15 at 2 a. m.
June	15 at 10 p. m.
July	**15 at 8 p. m.**
August	15 at 6 p. m.

Scorpius

THE NAME of the constellation is very significant and some figures of Scorpions are found in Babylonian inscriptions. This is one of the Zodiacal signs in which the Sun apppears to lie only for the last nine days in November and then moves into Ophiuchus.

According to Indian mythology and ancient astronomical reckoning the four bright stars, in the claws and in the mouth of the scorpion, constitute the Nakṣatrās (नक्षत्र) of *Viśākhā* (विशाखा) and *Anurādhā* (अनुराधा) respectively. The body of the Scorpion, with its three bright stars, constitutes the *Nakśatra* of *Jyeśtha* (ज्येष्ठा). The nine stars in a curve forming the sting of the scorpion constitute the *Naksatra* of *Mulā Barhini* (मूळ)

The constellation is a very familiar one. It is easily recognized and it is spread over a large area.

According to a Greek legend, this is the Scorpion, which frightened Phaeton,* the rash child of Apollo, while he was driving his father's chariot along the Ecliptic.

According to another legend, this is the poisonous scorpion that stung the mighty Hunter Orion.** Orion was very vain and he had on one occasion boasted that the could subdue any beast with his club. Juno desired to teach him a lesson and arranged matters in such a way that the scorpion could sting him in the heel. [After the incident, however, Juno tried to atone for her own wicked action and arranged to have both Orion and the Scorpion placed among the stars.

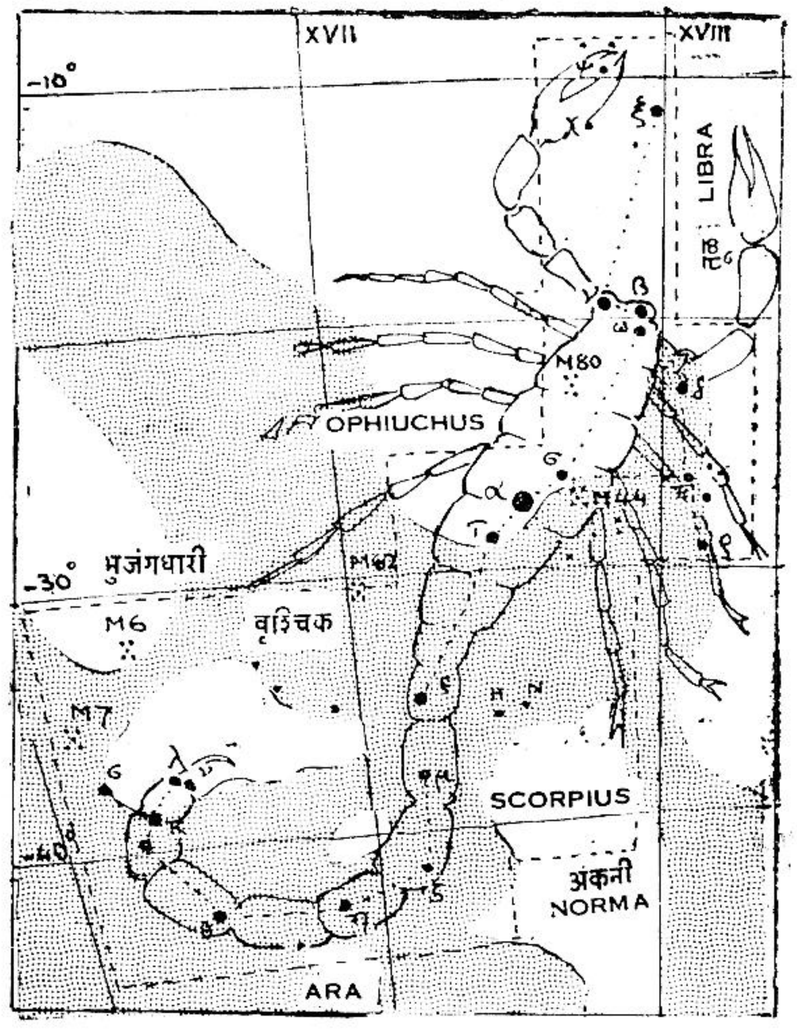
The bright star α is red. It is called Antares, from the time of the Greeks, because of its similarity to the red planet Mars in regard to colour. Antares is a super-gaint, having a diameter 285 times that of the Sun. Its mass is 30 times that of the Sun and its luminosity about 30,000 times.

Antares is a double, but its companion is very faint. There is a bright globular star cluster near star α and it is called M 4. The other cluster M 6 is above the tail end of the Scorpion. It is a galactic cluster and it appears like a butterfly with open wings.

The other stars are named as follows :

β (Akrab or Anurādhā), δ (Zuba or Anurādhā) and λ (Showla or Mūla Barhiṇī)

The Cluster M 7, also near the sting, is a brilliant open cluster visible to the naked eye.

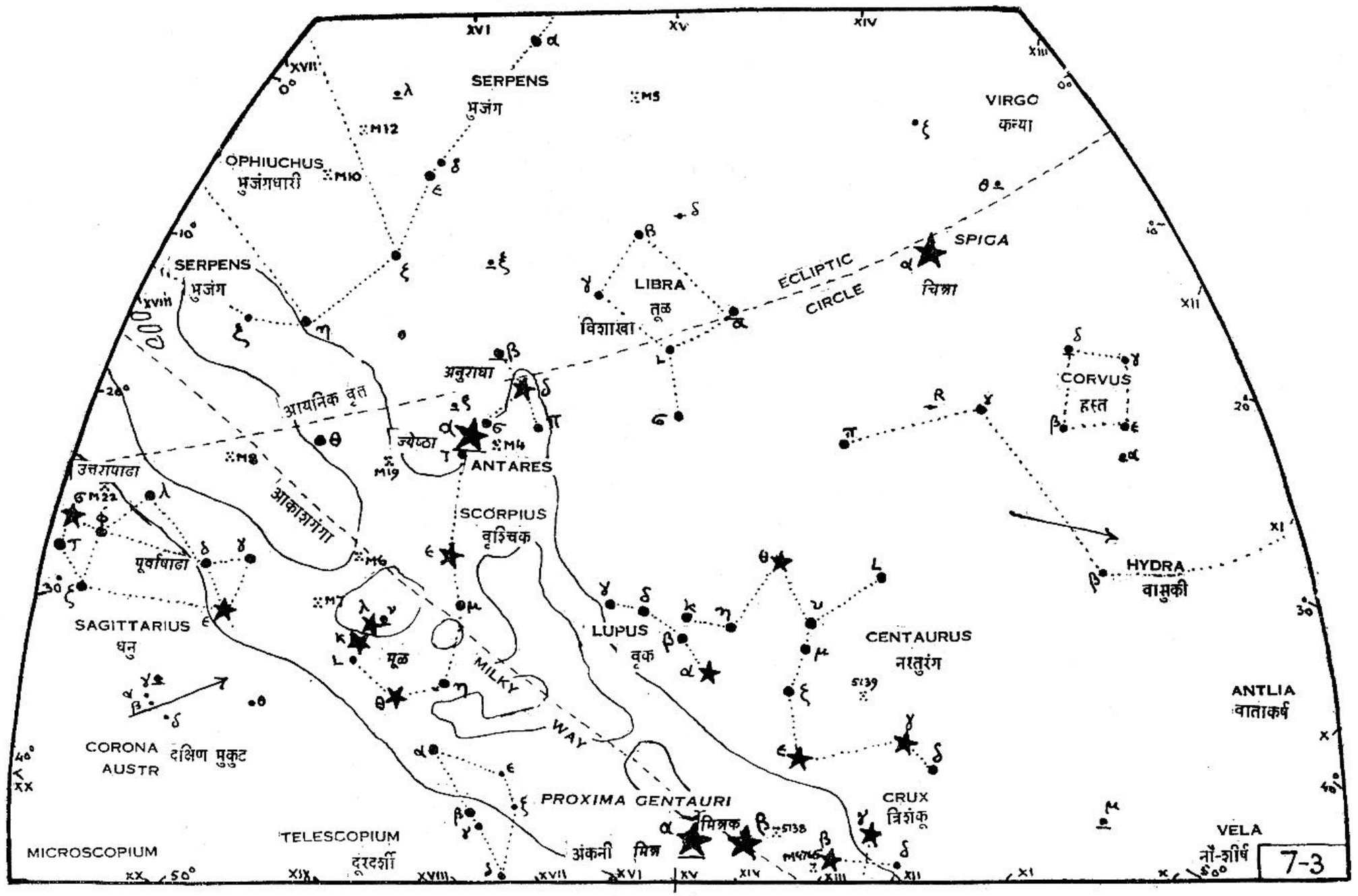


Eig. 7.3 : Scorpius (Vṛscika)

* See *Eridanus* at page 43.

** See *Orion* at page 47

* * *



Observer's Latitude : 25°N

JULY
SOUTH
KEY-MAP

March	1 at 5 a. m. (I. S. T.)	March	15 at 4 a. m. (I.S.T.)
April	1 at 3 a. m.	April	15 at 2 a. m.
June	1 at 11 p. m.	June	15 at 10 p. m.
July	**1 at 9 p. m.**	**July**	**15 at 8 p. m.**
August	1 at 7 p. m.	August	15 at 6 p. m.

JULY : SOUTHERN SKY

Prominent Stars :

α in Centaurus (Al Kentaurus).
β in Centaurus.
α in Libra (Zuben el Genuti), lies on the Ecliptic.
α in Scorpius (Antares).
α in Virgo (Spica), lies on the Ecliptic.

Double Stars :

α in Centaurus; splendid binary, 0.3 and 1.7 magnitudes.
α in Crux, pair of 1.4 and 1.9 magnitudes, seen with a 2.5 cm. telescope.
α in Libra, wide double 230″ apart.
α in Scorpius, with faint companion, red and green,
β, γ, σ in Scorpious, wide doublets.
ξ in Scorpius, seen with a 5 cm. telescope.
ν in Scorpius has a companion and each is a close double.

Variable Stars

δ in Libra, Algol type, varies from 4.18 to 6,2 magnitudes.
τ in Centaurus; long period of 90 days; magnitudes 5.2 to 10.0

Nebulae and Star Clusters

NGC 5139 in Centaurus, globular, seen with naked eyes.
NGC 3766 in Centaurus, with about 200 stars, seen with a binocular.
M 4 (NGC 6121) in Scorpius, near Antares, bright and globular.
M 7 (NGC 6475) in Scorpius, open cluster, seen with naked eyes.
M 8 (NGC 6523) in Sagittarius, 'Lagoon Nebula' seen with naked eyes.

* * *

Some Beautiful Views of Nebulae

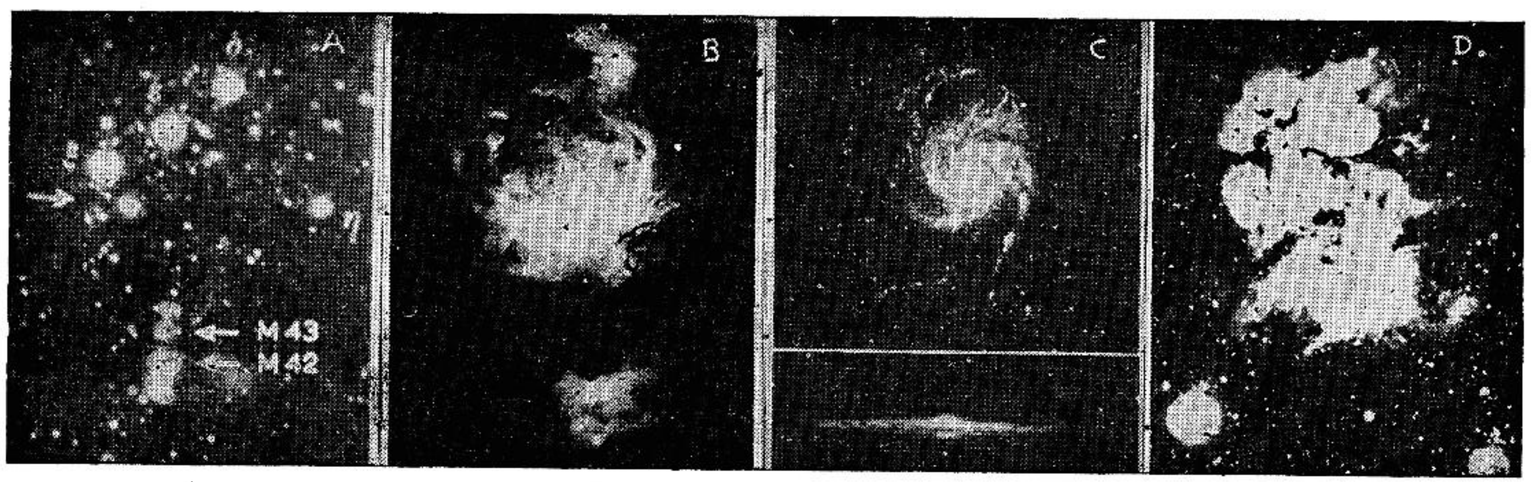
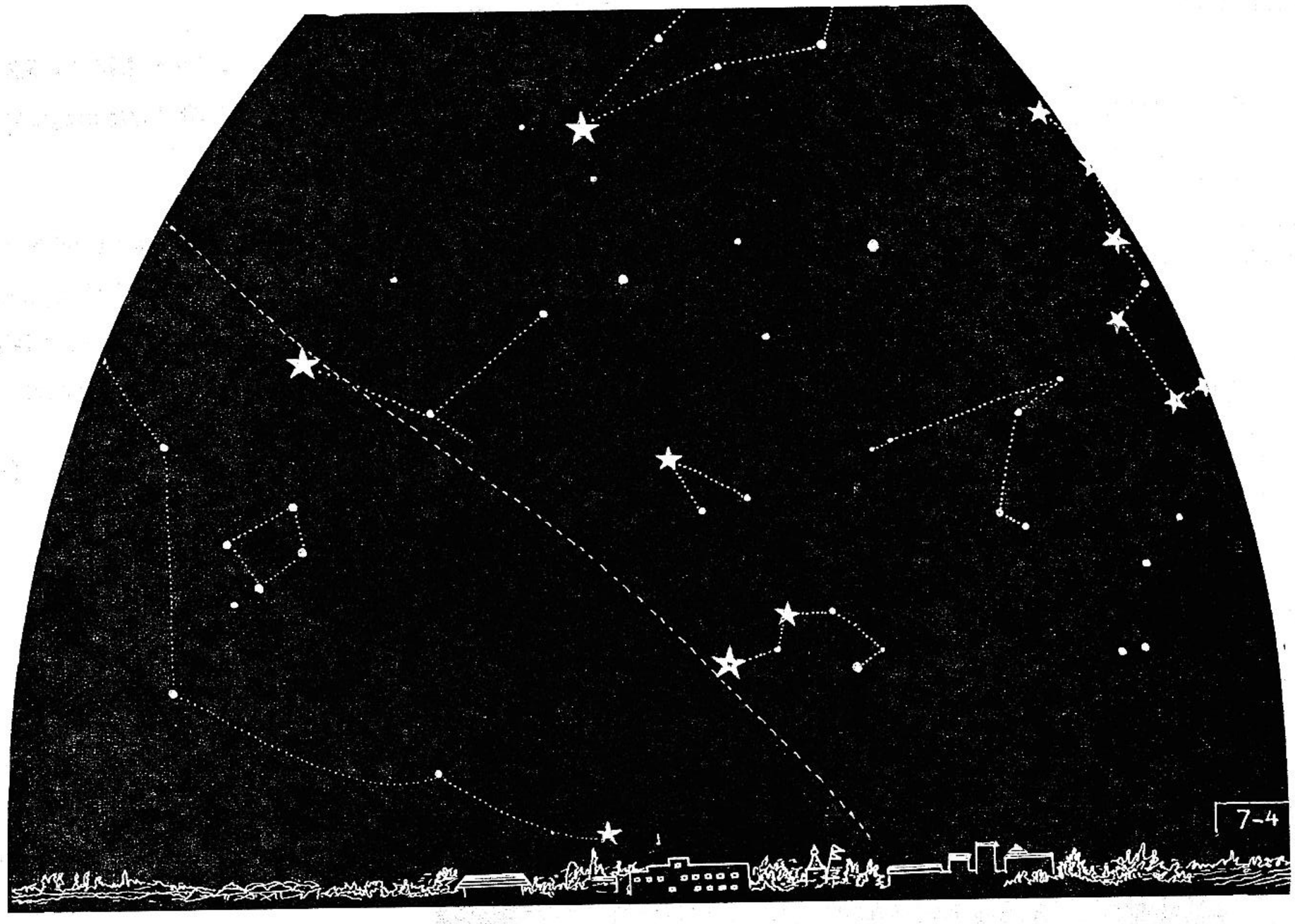


Fig. 7.4 : Photographs of Nebulae A, B, C, D.

A. Nebulae M 42, M 43 ; below the arrow in Orion.
B. Large and bright Nebula M 42 in Orion (90 cm. telescope).
C. Two different views of two Spiral Nebulae.
Front view : M 101 in Ursa Major.
Side view : NGC 4505 in Coma Berenices.(90 cm. telescope)
D. Triffid Nebula M 20 in Sagittarius (250 cm. telescope).

* * *



Observer's Latitude : 25°N

JULY
WEST
NIGHT-SKY

March	1 at 5 a. m. (I. S. T)	March	15 at 4 a .m. (I.S.T.)
April	1 at 3 p. m.	April	15 at 2 a .m.
June	1 at 11 p. m.	June	15 at 10 a. m.
July	**1 at 9 p. m.**	**July**	**15 at 8 p. m.**
August	1 at 7 p. m.	August	15 at 6 p. m.

Delphinus

THIS IS a small but conspicuous constellation of the northern hemisphere lying between Aquila, Aquarius, Pegasus, Vulpecula and Cygnus. It contains 5 rather close stars of magnitude 5.

The popular English name for this star-group is Job's Coffin and the origin of this strange name seems to be in the "diamond-shaped" form in which the stars can be joined up.

The constellation is known as Delphinus. According to one legend, this name has been chosen in honour of a Dolphin, a kind of sea-fish, connected with the adventures of Arion, who was a famous musician of Corinth. According to another legend, this particular sea-fish or Dolphin used to carry Neptune on its back across the sea, when he was courting the sea-nymth Amphitrite. Afterwards when the courtship resulted in a marriage, Neptane, out of gratitude, placed the Dolphin among the stars.

The five fairly visible stars in Delphinus can be connected by means of lines to produce the figure of an Indian musical drum known as *Mṛdaṅga* (मृदंग). Some imagine that the shape of the constellation resembles the 'comma' sign in writing.

Indian name for Delphinus is *Dhaniṣṭhā* (धनिष्ठा).

The prominent star-names are α (Nicolaus) and β (Venator).

The star γ at one end of the longer diagonal of the diamond-shaped constellation is a double for 5 cm. telescope, and the components appear yellow and emerald in colour. On the tail of the constellation, that is on the line joining β and ε, there are two star clusters. One of them is about 150,000 light-years distant from us.

* * *

Vulpecula

THIS IS a small constellation consisting of many faint stars and lies in the Milky Way, on the northern side of Delphinus and between Cygnus and Aquila.

Vulpecula means the little Fox. The nomenclature is modern. The group contains no star brighter than magnitude 6 and provides a test of visibility by the naked eye.

One star, bearing number 6, is a wide optical double. The companions are of magnitudes 4.5 and 5.7 and are 400″ apart. Even a small telescope can be used to see them separate. There is a beautiful planetary Nebula, M 27, otherwise called NGC 6853. of magnitude 7 but its structure can be revealed only with a 25 cm, telescope. Its distance is 100 parsecs or 320 light-years from us.

* * *

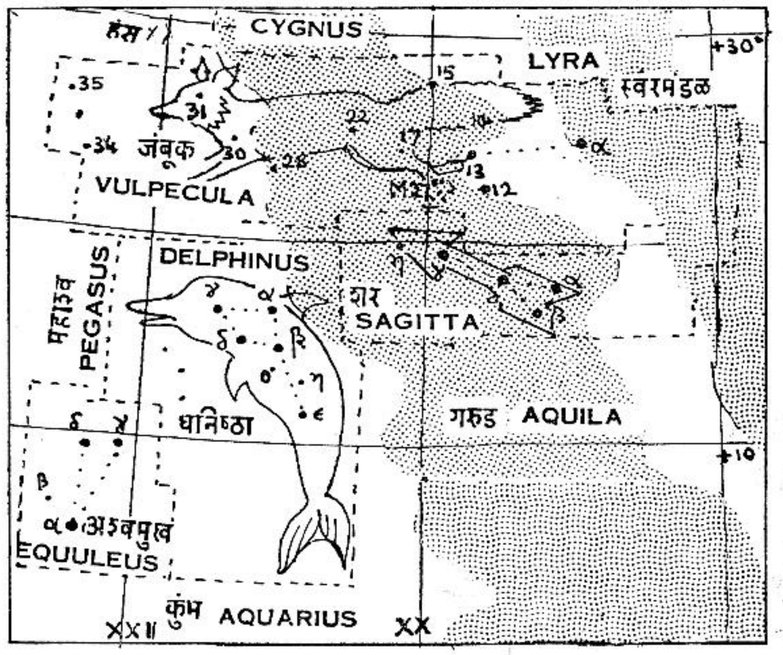


Fig. 7.5 : Delphinus, Vulpecula, Sagitta

Sagitta

THE NAME means the Arrow. It is a constellation of the northern hemisphere, lying north of Aquila and south of Vulpecula. There are 4 stars of magnitnde 4 and they make up the figure of an arrow, hence the name Sagitta,

* * *